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~~FIFTH~~ ANNUAL REPORT

OF THE

TRUSTEES

OF THE

Massachusetts Agricultural College.

1864, '66-74

~~JANUARY, 1868~~.

BOSTON:
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1868.

HOUSE....No. 11.

Commonwealth of Massachusetts.

BOSTON, January 6, 1864.

To Hon. ALEXANDER H. BULLOCK, *Speaker of the House of Representatives:*

The undersigned, a Committee of the Trustees of the Massachusetts Agricultural College, having it in charge to make the annual report to the legislature, which is required by the fifth section of the 220th chapter of the statutes of 1863, incorporating said Trustees, have the honor to make the following communication.

The corporation was organized, in conformity to the statutes of this Commonwealth on the 18th day of November, 1863, and the following officers chosen, to wit: His Excellency John A. Andrew, President; Hon. Allen W. Dodge, Vice-President; and Charles L. Flint, Secretary. The election of a Treasurer was deferred to a future time. By-laws were adopted for the government of the corporation, a copy of which is annexed hereto.

A Committee of the Trustees, consisting of Messrs. Marshall P. Wilder, Henry L. Whiting, Phineas Stedman, Nathan Durfee, Henry Colt, Charles G. Davis, and George Marston, has been appointed to "have in charge the raising of subscrip-

tions to the funds required by law to put the Agricultural College in operation, and also to consider the subject of a location for the College, and to receive proposals concerning the same, and to report to each meeting of the Trustees the progress they have made."

Several propositions have been made to this committee with reference to the location of the College, which are under consideration. A very liberal disposition is manifested, in several localities, with reference to raising and offering funds to aid in the establishment of the College. None of these have been sufficiently considered and matured to be the subject of special report.

Two vacancies exist in the Board of Trustees, which the legislature will be called upon to fill;—one arising from the lamented decease of Hon. John Brooks, of Princeton, from whose intelligence, liberal public spirit, and zeal in the cause of agriculture, we might have expected valuable counsel and assistance; and the other from the resignation of Dr. John B. King, of Nantucket, which was communicated to the first meeting of the Trustees.

As no funds have yet come to the corporation there is no report of its financial condition to be made.

Respectfully submitted on behalf of the Trustees.

GEO. MARSTON,
WM. S. SOUTHWORTH,
CHARLES L. FLINT,
Committee.

BY-LAWS.

Of "the Trustees of the Massachusetts Agricultural College."

1. A regular meeting of the Trustees shall be held on the first Wednesdays of November, February, May, and August, in each year, at the State House, at eleven o'clock in the forenoon. Special meetings may be called at any time upon the written request of the Governor, or of any three members of the Board of Trustees. Such request shall be made to the Secretary, who shall thereupon give notice in writing to each member of the Board, not less than seven days before the meeting.

2. The officers of the corporation shall be a President, Vice-President, Secretary, and Treasurer, and such committees may be chosen from time to time as the Trustees at any meeting may think expedient.

3. The officers of the corporation shall be chosen annually by ballot, and the regular meeting which shall be held on the first Wednesday of May, in each year, shall be the annual meeting for this purpose.

4. These By-Laws may be changed, amended, and additional by-laws may be adopted at any annual meeting of the Trustees without any previous notice for that purpose, and at any regular meeting of the Trustees, provided notice has been given in writing, to each of the Trustees, at least seven days before such meeting, that the subject of the by-laws will be brought before the meeting. And such notice may be given either by the Secretary or by any one of the Trustees who desires to propose any change of the by-laws.

3d Rept

SENATE....No. 39.

Commonwealth of Massachusetts.

ANNUAL REPORT
OF THE
MASSACHUSETTS AGRICULTURAL COLLEGE.

To the Senate and House of Representatives in General Court convened.

In accordance with the requirement of the Act of incorporation, that "the corporation shall make an Annual Report of its condition, financial and otherwise, to the Legislature," the President, by direction of the Board of Trustees, submits the following—

REPORT:

Our annual report of last year sets forth the conditions of the grant by Congress for agricultural colleges, the acceptance of the grant by the Commonwealth, the location of the college at Amherst, with the reasons therefor, the purchase of a farm of between three hundred and four hundred acres there, the subscription of $75,000 for the erection of buildings, the sale of the land scrip so far as accomplished, and the steps taken toward the organization of the college.

Two vacancies then existing in the board of trustees were filled by the election of Henry F. Hills and E. Francis Bowditch, so that the board is now composed of the following members: Marshall P. Wilder, of Dorchester; Charles G. Davis, of Plymouth; Nathan Durfee, of Fall River; Henry Colt, of Pittsfield; Charles C. Sewall, of Medfield; Paoli Lathrop, of South Hadley; Phinehas Stedman, of Chicopee; Allen W. Dodge, of Hamilton; George Marston, of Barnstable; William B. Washburn, of Greenfield; Henry L. Whiting, of Tisbury; D. Waldo Lincoln, of Worcester; Henry F. Hills, of Amherst; E. Francis Bowditch, of Framingham; and Henry F. French, of Amherst; Alexander H. Bullock, of Worcester; Charles L. Flint, of Boston; and Joseph White, of Williamstown; the last named four being each a member *ex officio*.

At the annual meeting in May, the following officers of the board were elected: His Excellency John A. Andrew, President; Henry F. French, Vice-President; Charles L. Flint, Secretary; Nathan Durfee, Treasurer; Allen W. Dodge, Auditor; Messrs. French, Lathrop, Colt, and Davis, Executive Committee, to which, on the 1st of November, Mr. Lincoln was added.

The Act of incorporation, as amended, requires that "the plan of organization, government, and course of study prescribed for said college shall be subject to the approval of the governor and council." On the third day of February, 1865, "a plan of organization and course of study," after most careful examination, was unanimously adopted by the trustees, and on the same day transmitted to the governor for such approval. After a full hearing on the subject before the governor and council, by officers of our board, the paper was, on the first day of April, returned to us by the governor, without having been acted upon by the council, with a suggestion that an approval at that time would be premature. At the quarterly meeting of the board in May, it was voted to lay the subject upon the table, and no further action was taken upon it until December 27th, when it was voted to present the plan to the incoming governor and council for approval.

It has seemed to the trustees desirable that their plan of organization should be early established, in order not only that their buildings and farm might be arranged in conformity with

it; but that they might publicly and officially answer the frequent and reasonable inquiries as to what they proposed to do for agriculture and education, by means of the college. Inasmuch, however, as their plan has no validity until approved by the governor and council, and is subject still to any amendment by the trustees, which their further deliberation or that of the governor and council may render proper, it has not been deemed expedient to publish it in full in advance of its final sanction; yet it seems due to the community, whose interests we have in charge, that some general statement of our views and intentions should be made public.

In a paper addressed to the governor and council, in September, 1864, by our executive committee, in behalf of the trustees, printed in Senate document No. 172, in 1865, we set forth, with some precision, our ideas as to what is required in our plan of organization by our charter, and by the Act of Congress granting the land for the colleges. These views, so far as they affected the immediate question which called them forth, which was the approval by the governor and council of our location of the college at Amherst, seem to have been satisfactory, and were sanctioned by the favorable action of the executive, and by subsequent grants of aid by the legislature. Our general plan has not since been greatly modified by further investigation. A few principles and circumstances seem to us to indicate clearly to our board what our duty in this behalf requires.

In organizing the college, we should keep constantly in mind, at the same time, the requirements of the Act of Congress and of our charter, and the facilities for education already afforded by our common school system, and the various existing colleges and other institutions of learning. Our college is to be established as a part of the great scheme of public education; not in opposition to our grammar schools and high schools, but in harmony with them; not as a rival to our other excellent colleges, but as a co-worker with them in a common cause, supplying some facilities for the investigation of physical science, and some practical teachings in "such branches of learning as are related to agriculture and the mechanic arts," which can never be afforded by existing colleges, without sacrificing their essential character of classical schools, and adding farms, implements, and live stock to their apparatus and museums.

Adaptation to our Political Institutions.

In deciding on a course of study and discipline for such an institution, we must ever remember that we live under a republican and not an aristocratic government. An agricultural college based upon republican institutions and adapted to them, will differ essentially from any college existing in a country controlled by an aristocracy. Aristocratic governments are constructed upon the idea of inequality in property, in education, and, *therefore*, in political rights and power. We use the word *therefore*, because wealth and education, monopolized by any class in any country, will draw to that class the political control of that country. The foundation stones of republicanism or democracy, as distinguished from aristocracy, are the ideas of Equality, Progress, and the Dignity of Labor. The distinctive principles of an aristocratic government are, that a few are created to govern, and the rest to be governed, and that government is especially valuable to preserve these natural and proper relations in society, and prevent the lower orders from struggling upwards to the disturbance of the system. It requires less intellect in general to perform manual labor than mental labor. Peasants and serfs and slaves can dig and pick cotton, under task-masters, as well as graduates of universities, and are far more obedient and docile in such positions. In all aristocratic countries, therefore, no matter by what name we call the government, the peasant, the serf or the slave performs all the manual labor, and labor becomes degrading, merely because degraded, ignorant persons perform it.

Labor is not dishonorable in England, merely because it is hard for the physical system. A gentleman in a fox-chase, or a university student in a boat club, will cheerfully endure more hard work than he would impose on any servant. But in those countries wealth and education monopolize the positions which ignorance cannot fill, if it were allowed to try, and so all political offices, and all the professions and posts of honor of every kind are filled by the aristocracy, leaving poverty, ignorance and hard work for the masses. The boys in England grow up with the idea that manual labor is for peasants; the planter's son regards labor as fit only for slaves; and, in both cases, the desire of the governing classes naturally is to perpetuate these notions. Thus the idea of progress is excluded, and the asso-

ciation of labor with servility and ignorance is maintained. Even the comfortable farmer of England, on his thousand acres of leased land, is as unconcerned about public affairs as one of his own fat bullocks. He trusts his spiritual affairs to the Church, and his political affairs to his landlord, and cares not what party rules, provided the markets are good.

The poorest graduate of a Massachusetts high school, with no capital but his brains, and no tools but his jack-knife, has rightfully more interest in the government, and a broader field of enterprise and usefulness open to him, than the son of any man however wealthy, of the middle classes in the aristocratic countries of Europe.

Republicanism has undertaken in America to recast society into a system of equality. It proposes to create true and safe equality, not by conferring on the ignorant and degraded the rights of citizenship, but by raising all, through education, to the full dignity of freemen. Its purpose is to diffuse education and property among all the people, to give as nearly as possible every child an even start in the world, and an equal chance to be president, member of Congress, farmer, or mechanic as he may choose. To effect this, our fathers abolished hereditary rank. In England the king's son is born to be king, and the lord's son to be a lord, and the oldest son inherits all his father's lands.

In our country, the president's son has no better claim to be president than another, nor a senator's son to be senator; and all the sons and daughters share alike the father's property.

Then comes in the great regulator and elevator, general education, like a huge subsoiler, breaking up the old foundations trampled down by the heavy feet of the weary laborers, as they toiled on for centuries, like beasts in the furrow, and this must finish the work.

Equality in education, in wealth, in power, so far as God has permitted, is the key-stone of the arch of liberty, which our fathers established. As men who believe these things, not as mere glittering generalities, but as vital, practical, eternal truths, how shall we build up an agricultural college?

The Agricultural College at Cirencester is the only institution of the kind in England, and this has proved a failure, so that in 1862, says Mr. Flint, it was $150,000 in debt, and all

its professors had resigned. Dr. Hitchcock, in his Report in 1851, shows us the fatal difficulties of an aristocratic agricultural college. The school was opened, he tells us, for the sons of farmers; but in 1849, out of seventy students, there was not one son of a farmer there. "Formerly," says Dr. Hitchcock, "the school was open for the sons of the smaller farmers, but could not find support on that plan, and it was found if those attended, the wealthier classes would not send their sons. The price, accordingly, has been raised, and none but the sons of gentlemen, such as clergymen, and wealthy laymen, now attend. None of the nobility send their children, although many give their money for its support."

"Farmers," "gentlemen," and "the nobility," form three classes so distinct that they cannot attend the same school, and far below the lowest of those, is the whole class of laborers, ten times as numerous as all the other three, who are not thought of as having any place in such a school.

A careful reading of Mr. Flint's recent Report upon the Agricultural Schools of Europe must satisfy any one that we shall in vain look abroad for a model. The curse of aristocracy is upon them all. They are designed for the education of some one class, and not for the elevation of any man above the class into which he was born. If manual labor is required at all, it is required only of the lower class; that is, by classes composed of a lower order of students, who never go into the higher classes, thus keeping up the very idea of caste which it is our object to destroy.

The bill of fare of the agricultural boarders of the Albert National Agricultural Institution, near Dublin, in Ireland, may indicate whether we have any occasion to educate any such class. The whole breakfast, five days in the week, is "bread, three-quarters of a pound; and sweet milk, one pint." The other two days they have the same quantity of bread, and one ounce of butter, and tea or coffee. Every day, year out and year in, their supper is the same, "oatmeal half a pound, in stir-about, and skim-milk, one pint." The aristocracy of the school, of course, fare better. The Albert Institution is perhaps the best in Great Britain, and well adapted to the wants of the country, where the highest object is to train students for teachers in schools of lower grade, and for positions as land

stewards, to take charge of the farms of the nobility. There all the land is owned by the small aristocratic class, who perform no labor with their hands, and have no occasion to learn to labor. Here every man may have a homestead without price, and should personally know how, with his own hands, to render it profitable.

We must remember, however, that although with us, all men are born equal, and education is open to all, there are few who can devote their lives to learning, and that a system of education based upon republican ideas, must be such as is best adapted to the wants of the many, and not of the few. It may fairly be assumed that the great mass of our young men must complete their school and college education at about twenty-one years of age, and after that, devote themselves to getting their living.

Our common schools, up to the general standard of admission to our colleges, carry all alike, rich and poor, in even ranks, giving them a good general education, in English branches; and in our high schools considerable advancement in Latin, with French and Greek in the larger towns. Existing colleges and schools afford everywhere opportunity for education in the classics, and in abstract mathematics. There is no demand in that direction, for another college in this Commonwealth.

Demand for Modification in College Education.

There is, however, an impression quite common, both in this country and abroad, that in existing colleges, too much of the usual four years course is devoted to Greek and Latin and abstract mathematics; and our colleges have all been recently giving way to this idea, and allowing the modern languages to be taken as electives, to some extent, instead of them. Scientific schools too, have been established in connection with the colleges, to give the more practical teaching which they who expect to occupy positions of actual business have seemed to demand. The Institute of Technology, recently opened in Boston, under most favorable auspices is, we understand, already crowded with pupils, seeking the special education which may fit them in the few years they can give exclusively to study, for the practical affairs of life.

Even in England, where the importance of the education of the masses is by no means appreciated as in this country, the universities of Oxford and Cambridge have recently admitted that their exclusive course of instruction has not been adapted to the wants of modern times, and have added a new feature to their old system. We refer to what are known in England as

The Middle Class Examinations.

On the 18th of June, 1857, the university of Oxford passed a statute, establishing examinations of those not members of the university: one for youths under eighteen, another for boys under fifteen. A commission was authorized to frame a scheme of examination, appoint examiners, and arrange all the details of the examinations, which are held at various centres, chiefly the large towns. Certificates are given to those under fifteen who succeed in the lower examination; and youth under eighteen who pass the higher examination, receive the title of Associate of Arts.

The university of Cambridge in England, has followed the example of Oxford, and provided for similar examinations.

The objects of these examinations are, to encourage the middle classes in the pursuit of learning, to guide them in their course of study, and finally to test their progress, and grant them such certificates of ability, as shall give them the positions in business life for which they are found qualified.

It was perceived in England, as here, that no adequate education was provided for business life. Of two hundred boys in a grammar school in Leeds, only three, on an average, go yearly to the universities. The others go directly from the grammar school to such business as they can find.

Under the new arrangement it is hoped, that young men designing to engage in trade, in art, in science, in manufactures or in agriculture, may be encouraged to pursue their studies in the course indicated by the universities, in order to avail themselves of the certificates or titles thus publicly conferred.

Parliamentary Report.

A "Report of Her Majesty's commissioners appointed to inquire into the revenues and management of certain colleges

and schools, and the studies pursued, and the instruction given therein," presented to Parliament in March, 1864, in four folio volumes, has given to the world some astounding disclosures as to the defects of the system of education pursued in England, showing how manifest errors in a matter of vital interest to the public, may be tolerated under an enlightened government, from generation to generation. We have not space to do more than glance at this subject. In brief, it may be said, that this report shows that in the great schools of Eton, Westminster, Harrow, Winchester and Rugby, physical science, including chemistry, natural philosophy, geology, astronomy and botany, form no part of the regular course of study, and French and German fare little better. At Eton, out of 780 students, only twenty studied German; and about eighty attended to French as an optional study, with little regularity. At this most aristocratic of schools, only thirty-five pupils attended to drawing, and music was not taught at all.

"At Winchester," says the Rev. Mr. Moberly, for twenty-seven years the head master there, "we do not profess to teach modern history at all," and "it is plainly out of the question that we should teach chemistry, astronomy, geology, &c." To the question, "Are the physical sciences not of value as a discipline of the mind?" he replies: "I hardly know what their value is. I do think it is very desirable that young people and old people should know these things; I think they are matters of accomplishment and knowledge, which everybody should know something of, but as a matter of education and training of the mind, which is our particular duty as instructors, I do not feel the value of them."

If the question is asked, what is taught at these great training schools for Oxford and Cambridge, the answer is, Latin and Greek, and to some little extent, mathematics. When, however, the commission follows its investigation farther, it would seem that what little these pupils had learned at the schools, they had forgotten at the university. Mr. Neate, M. P. for Oxford, gives the following as his estimate of the grand result of education at a classical school and Oxford, in these words:

"I do not hesitate to say, that the great majority of those who take a degree in Oxford, after having spent ten or twelve years of their life in the all but exclusive study of Latin and Greek, are unable to construe off-hand, the easiest passages in either language, if they have never seen them before, and that their Latin writing is almost invariably such as would, under the old school system, have subjected them to a flogging, as boys of twelve years old; and those who take first classes, often make such mistakes as make it difficult to understand how they ever got simply a degree."

The commissioners in their report say, "of the young men who go to the universities, a great number never acquire so much Latin and Greek as would enable them to read the best classical authors intelligently, and with pleasure, and more than half of those who leave school do not go to the universities at all; among these the average of classical attainment is lower still, and probably in nine cases out of ten, they never, after they have quitted school, open a Greek or Latin book." A foreign reviewer of this report says: "Under the recent examination statute of the university of Oxford, the portion of ancient history taken in by the student, who is not a candidate for honors, at his final examination is, three books of Herodotus, four books of Livy, or four books of Tacitus. Three books of a Greek or four of a Latin historian, are the largest amount of ancient history, which the extreme difficulty of the dead language in which that history is contained, permits the university to require of an ordinary student. From such a mere segment, he can hardly learn more of the historical wisdom of the ancients, than he could of the beauty of St. Mary's church from a single window. Nor does he, any more than the boy who leaves school without coming to the university, open his classics again when his last examination is past. In these, the majority of cases, to talk of the glories and the treasures of ancient literature is really little better than nonsense."

Excellence of our General System of Education.

We would by no means be understood as intimating that the preparatory or college course of education in this country is open to such criticism. Our whole system of schools has

been already republicanized. Our common schools are the chief glory of the State. Our colleges, we claim as democratic institutions, as the great levellers of society, levelling in the right way, *up* and not *down*, that enable the son of the poor man to rise to the highest positions of influence and honor. The colleges, however, it must be everywhere admitted, fit no one for the actual duties of any profession, art or business of life. They do not profess to do so, but merely to give a training preparatory to special education for some particular business. Their graduates, for the most part, pass into the professions, a few into the scientific schools, and almost none into agricultural pursuits. There are special schools for divinity, law and medicine, but no schools for the farmer as such.

Agriculture, the foundation of all national prosperity, has heretofore received no such aid in her advancement. To a new class, we would now open our college halls, supplying a great want in our general system of education, and hoping rather to attract to our academic groves those who would otherwise neglect a course of college study, than to withdraw from existing institutions, any who are tending toward them.

In all our colleges the four years course is fully occupied with study. Indeed the error is rather of overwork than of idleness or insufficient exaction. If but four years can be devoted to the college course, and other studies seem to us more important than those pursued in existing institutions, we have no choice but to discard a portion of the latter to make room for others that we deem essential.

Again, it is generally admitted by those engaged in teaching, that boys differ in their aptitude for the various branches of learning.

One seems born a mathematician, and almost performs miracles in that direction, while it is in vain to attempt even to keep him in classes with others in Latin and Greek.

Another has an aptitude for languages, and acquires them almost by intuition, while a third runs wild in pursuit of birds and beasts and flowers, and feels any restraint in school as a punishment; and a fourth seems to be a natural mechanic, and will take the old house-clock to pieces and reconstruct it, almost before he can read. While we by no means advocate the idea

that boys should be allowed to neglect the ordinary course of early education, on account of any distaste they may feel for a particular study, yet it is rarely expedient to try to force the progress of a youth old enough to enter college, in any pursuit, against what seems to be his natural taste.

This natural or very early developed diversity of taste, or adaptation for special branches of knowledge may, we think, be properly met at the age of about sixteen, by offering a choice between the Latin and Greek and dry mathematics of existing colleges, and institutions like ours, where agriculture is specially taught, and where modern languages and physical science are made prominent, and where a love of nature may be cherished in familiar converse with her various works.

Our first duty we apprehend to be, to make the college distinctively an agricultural institution, to establish a course of study which, if faithfully pursued, shall make every graduate a scientific and a practical farmer, capable of performing every variety of work upon a farm with his own hand, and capable of directing and managing the affairs of an estate, however extensive.

But this is by no means all our duty. As we propose to consume, in our course, as much time as the other colleges, and to complete, so far as instruction goes, the education of our students, our course should be such as to answer the great ends of education, the best discipline of the mind, with such physical training as may best secure the full and healthy development of the body, with the highest esthetic and moral culture.

Connected with the department of physical culture, is a provision for instruction in military tactics, as required by the Act of Congress.

Plan of Organization.

The estate, which comprises nearly four hundred acres of excellent land, affording great variety of surface and soil, is to be furnished with model farm buildings to be erected from time time, as the increasing productiveness of the farm shall require, to be supplied with farm implements of the most approved kinds, and stocked with a variety of the best thoroughbred and other animals that we may be able to procure; the farm to be conducted, primarily, for the education of the pupils, by way

of illustration in agriculture, horticulture, botany, stock growing and other rural affairs.

A college building, to be immediately erected, for lecture and recitation rooms, library, museums of natural history and of farm implements and products, chemical laboratories, halls for exhibition and military drill, armory and chapel, and rooms for the president, librarian, and other officers.

A president, who shall reside at the farm, and have general charge of its affairs under the trustees; a faculty, composed of the president and resident professors, who shall administer the government and execute the prescribed regulations, and a farm superintendent, who shall direct the ordinary labor, and manage the details of business on the farm.

The following departments, under such professors and assistants as may be necessary: A department of Agriculture and Horticulture; a department of Physics, Mathematics, and Engineering; a department of Natural History; a department of Chemistry; a department of Political Economy, Intellectual Philosophy, and Christian Morals; a department of Comparative Anatomy and Animal Physiology, including Veterinary Surgery and Medicine; a department of Modern Languages and Literature; and a department of Physical Education, including Military Tactics.

The general course of study to be four years, with provisions for shorter elective courses.

For admission, students to be sixteen years of age, and to pass such examination as is required for admission to our Normal Schools, and such further examination as shall be prescribed.

Manual labor to be required daily of every student, as may be arranged by the faculty, who may allow compensation for extra work. Tuition to be fixed by the trustees, with such free scholarships as may be established by public and private bounty.

Remarks upon the Plan.

In the full discussions of our scheme among the trustees, in conversations with officers of other agricultural colleges, and with those engaged in education in the ordinary course, in the suggestions of the press and of speakers at agricultural meet-

ings, we may fairly assume that we appreciate, to some extent, the criticisms that may be made upon a plan of organization like that of which an outline has been given.

The difference of opinion is found to be more in the expected development of the plan than in the departments of learning to be established.

The course of study recommended by Doctor Hitchcock for an agricultural college, in his report in 1851, does not differ essentially from that suggested by Governor Andrew in his annual address of 1863, and the principal features of both are found in our own plan, and in those of the agricultural colleges of Pennsylvania and Michigan. Indeed, a member of the Board of Education has assured us that there is not a branch of learning prescribed by us, that is not taught, to some extent, in every high school in the Commonwealth.

When, however, we consider that by its charter, our institution is styled an Agricultural College, that we are required to have an extensive farm attached to it, that manual labor is to be required of the students, and that Latin and Greek are not to be prominent, we perceive at once that although most of the studies are such as make up in part the course pursued in all modern education, yet the result of our training on the character and habits of the student, if we keep our peculiar landmarks in view, must be entirely different from that attained at our other colleges.

Physics and engineering and natural history are branches included in every college course in New England.

We propose, however, to teach the application of science, practically, to farm labor, to the construction of roads and bridges, of houses and barns, to surveying and levelling, to irrigation and drainage. Architecture in its broadest sense, both as a science and an art, should be taught, and prominence should be given to hydrodynamics, pneumatics, climatology, landscape gardening and draining, to the laws of light, heat and sound, and especially to their application to the construction, warming, lighting and ventilation of buildings.

Natural history should be taught with special reference to the farm; botany as applied to plants in the various uses for food, shelter and ornament; zoology as applied to the history, structure and reproduction of domestic animals, and of birds,

beasts and insects useful or injurious to man; geology as applied to the formation and constitution of soils, as affecting their general fertility or special adaptation to particular crops.

Following out through each of the departments of our college this idea of combining the practical application of principles of art and science to every day life, with the mental, physical, esthetic and moral discipline afforded by the other colleges, we hope to furnish a course of education peculiarly attractive and useful to such as intend to pursue agriculture as a business, or even to build up for themselves tasteful rural homes.

INABILITY TO PROCURE TEACHERS.

On the part of those who advocated a union of the Agricultural College with Harvard University and the Bussey Institution, it was fairly enough urged, that to make the college worthy of the Commonwealth, if independently established, would require a large amount of funds above what the grant of Congress would afford. To this, it is as fairly answered that the legislature having almost unanimously determined that the institution should be independent, the resources of the Commonwealth, both public and private, are abundant to make it worthy of the honored name it bears.

It has been objected, also, that existing institutions already engage the services of the great leading minds in the several departments of science, and that suitable professors and teachers cannot be obtained for an independent institution.

There is much apparent force in this suggestion. It is, however, no disrespect to any existing institution to maintain, that no one of them has within itself, a corps of instructors competent to manage an agricultural college. Wedded to their own approved and time-honored theories, almost unanimously distrusting the possibility of a union of manual labor and study, accustomed to instruct mainly in theory, unfamiliar with practical agriculture, believing that Latin and Greek furnish the the best discipline for the youthful mind; the agricultural college, thus connected, would of necessity, sink into a subordinate branch of the university, and fail of all its purposes.

That there are men in our colleges, at the very head of those departments of learning which we seek to make most prominent

in our institution, we cheerfully admit. That we hope to avail ourselves largely of the valuable services of these men we are happy to avow.

They, however, who advocate the union of all the masters of science in one grand university, we think confound somewhat the objects of our institution, and misapprehend the practical relations of these master minds to young students.

The objects of institutions of learning are twofold—the diffusion and the advancement of knowledge. Our common schools add nothing to the sum of human knowledge from year to year, but only diffuse that already attained, and the same is true of our colleges. The undergraduate, in his four years, is not expected to excel Cicero in Latin, or Euclid in mathematics. If he has acquired all that his tutor had acquired at graduation, he has gained all that was proposed for him. The measure of the scholar's acquirement is the limit of his own capacity, and not that of his teacher. The pupil can receive only what his cup will hold, however copious the fountain. The great names of the professors of zoology and anatomy at Harvard bring honor to that university, but these professors, it is understood, give no personal instruction to the under-graduates. Their lecture-rooms are, indeed, open to such, but their attendance is not required, and their time is fully occupied by the regular studies of their class. Practically, the presence or absence of such men as these is of little importance to freshman or sophomore. Men engaged in the highest realms of science, and who may be expected to enlarge its boundaries, are presumed to have attained the heights already explored. Their range of study is among the stars, above the reach of boys at school. They investigate alone, and make their discoveries in the study, in the dissecting room, in the laboratory, and the observatory, and do not spend their time in drilling boys upon the rudiments of science, which a recent graduate may do as well.

Applying these ideas to our college in its infancy, we say, that receiving a class at about sixteen, to remain through a four years course, our purpose is to give the students as much instruction as they are capable of receiving, in our several departments. In the organization of these departments, we desire to avail ourselves of the best talent in the country,

and we are satisfied that among the highest names connected with all our institutions of learning, there are few who have not both leisure and inclination to give, for proper compensation, as much of their time in courses of lectures on their special subjects, as may be practically useful to our college. We desire to secure for laborers constantly with us, as many professors of high attainments as practicable, but the very want, in times past, of such an institution as ours is intended to be, is the reason why teachers, exactly fitted to fill our professorships are very rare. In Michigan, some of the professorships in the agricultural college are already admirably filled by its own graduates.

Although our first care is for the classes who shall first come into our halls, and our first purpose to make of all who come, practical and scientific farmers, our ultimate aim is far beyond. Teachers and professors will soon be wanted in similar institutions, in all the Western and Southern States. Many young men, who have not farms, nor capital to buy them, may be attracted to our college with the purpose of supplying this demand. Massachusetts, the prolific mother of teachers, can do no nobler work for education and humanity, than to send through our wide borders, these heralds of her great ideas of liberty, equality and the dignity of labor. And farther still, when our classes shall one by one be filled, and our organization become complete, let us look still higher; let our motto still be PROGRESS; and let us pursue our study beyond the mere instruction of classes in their prescribed course, and endeavor by careful experiment in the field and careful investigation in the study and the laboratory, to make discoveries in science, and to enlarge the boundaries of existing knowledge, fixing no limits to our researches but the limits of finite intelligence.

Our idea has been to make our plan both simple and expansive, that it may be conformed, from time to time, to the wants of the people, and to the pecuniary means which may be secured.

OBJECTIONS CONSIDERED.

It has been objected to our scheme, as shadowed forth in the document referred to, that such an institution is not strictly an agricultural college, but rather a college with some agriculture

attached; and on the other side it has been charged, that the Act of Congress does not require an agricultural college, and that ours is too exclusively such.

The Act of Congress properly gives great latitude to the States in this matter, seeing that the new and old States have very different wants in education. The great difficulty, even in Michigan, whose system of general education is better, perhaps, than that of any other Western State, is to find scholars who are fitted to enter the agricultural college, and a preparatory class has been arranged at the college to meet this difficulty.

In Massachusetts, however high our requirements, we anticipate no difficulty in that quarter. In the new States, these colleges must begin lower, and provide for teaching the common branches. We, having excellent schools and colleges already at work, seem called upon to meet the wants not already supplied. We therefore make our course more distinctively agricultural at the outset, yet, as our pupils, in general, are expected to complete their education in our classes, we endeavor to carry them forward through such branches of common learning as belong to educated men in any position in life.

It seems often to be assumed, that the college is to be established for the education exclusively of the sons of farmers, and it is objected that by a high course of general culture we shall render our students unfit to return to the common labors of New England farms, by giving them ideas too exalted for the humble pursuits of agriculture.

This objection is based, we submit, upon radical misapprehension. The college is not designed for the benefit of the sons of any class of our citizens.

A college which should not open its doors as readily for the admission of the sons of the poorest mechanic, the wealthiest merchant, the minister, the lawyer, and the doctor, as of the farmer, would tend to establish caste, and would be utterly at variance with our common school system, and with the first principles of republican institutions.

"From what classes do you expect your pupils?" is often asked. Our answer is, from all classes. In the Michigan Agricultural College, a large majority of the pupils are sons of farmers, while in the Agricultural College of Pennsylvania, a large majority are from other classes, many of them from the

cities and large towns, so that we gain no light from that quarter.

The spirit of unrest which possesses Americans more than any other people, which prompts a man as soon as his house is built, to move away from it and go from a pleasant home to the wilds of Oregon, or the mines of California, is an almost necessary result of the development of free institutions in a vast, rich and diversified country. Here, instead of the right of primogeniture, by which the eldest son takes all the father's land, property is equally divided among all the children, and so the accumulation of great estates is prevented. Here, no seven years apprenticeship to any trade or business is required, and no man is born to rank or office, but each may do what his hands find to do,—a farmer in summer, a shoemaker, factory hand or tailor in winter, and by and by a member of Congress or president.

Again, there is a charm in rural life which a child always appreciates and never forgets. The merchant in the city sighs for a country home, and means, when he is rich enough, to return to the old homestead and be happy again as he was when a boy. He does not like to see his sons grow up in the Latin school and the university, ignorant of rural affairs, and may prefer to send them to the agricultural college. The farmer, on the other hand, is apt to think his own lot a hard one, and to regard the comforts and apparent ease of city or professional life, as more desirable for his sons. The boys themselves, who have great influence in the matter, assist in the decision.

The city boy imagines the farmer's life to be what he has seen in the country where he has passed his holidays, while the farmer's boy, as too often treated, associates farming with milking the cows before sunrise in winter, or dropping potatoes in the hot sun, or turning the grindstone, in summer. This circulation from country to city and from city to country, as generations follow each other, is healthful for a community like ours, tending as it does to promote harmony and equality.

Although by such influences, many, no doubt, from families other than the farmer's will find their way to our college, yet, since the land adapted to agriculture is generally owned by those who occupy it, and one son at least usually remains at

home, it is fair to suppose that the farmers will contribute the larger portion of our students.

Effect of such Education.

To the objection that we shall over-educate students, and so turn them away from farm labor and their love of the old homestead, we would answer, that neither our received theories of such education, nor our convictions of its effects, allow us any apprehension on this point.

Assuming that intelligent agriculture is the most agreeable and the most profitable employment for a large portion of our people; that the interest of the student in the wonderful processes of nature, in her formation of blade and bud and flower and fruit, in the reproduction of animals, in their various improved species, in the mechanism of new implements, and in the development of new processes of culture, will constantly increase with his knowledge, and that such knowledge will, at the same time render the pursuit of agriculture more manifestly profitable, we claim that our course of education will attach the student more strongly to a life upon the farm.

We contend, on the other hand, that ordinary college life tends to wean the student from home attachments, and especially from attachment to the farm. Four years of study, at the age when the character is most impressible, of branches not connected with agriculture, four years' association with young men preparing almost exclusively for the professions, four years' absence from the farm, the garden and the grand old woods, with four years' exemption from all manual labor, necessarily turn the thoughts of the young man away from agriculture and unfit him for the farm.

To counteract this tendency of ordinary college education, and give agriculture its due rank with the highest professions, is one of the grand objects of our enterprise.

It is true, no doubt, that some of the homesteads of New England may not be the most desirable places in the world, and that students, by a college education, may make discovery of this fact, and go elsewhere.

We apprehend, however, that no parent desires so to educate his son as to cheat him into a false belief on such a point.

No! give him education in the truth, and when he is graduated at the college, let his stand-point be elevated enough to overlook the whole country, and if cattle-raising in Texas, corn-culture in Illinois, cotton-growing in Carolina or sheep-husbandry in California, offer stronger inducements than market-gardening at Cambridge or tobacco-culture on the Connecticut, with the settled institutions of New England, let him go where duty and interest call him, well qualified for whatever he may undertake; and his father's blessing will not be withheld. And again, if after such education as we can give him, he finds in agriculture no such promise of profit or pleasure as to induce him to pursue it as a business, what harm if he turn to a profession or to trade, and make of agriculture a means of pleasant relaxation, or a collateral scientific study.

To diffuse through all classes the knowledge how to make a rural home pleasant, how to replace the bare and the bald with lawns, and trees, and shrubs, and flowers, with tasteful and comfortable buildings, is no unimportant part of a liberal education. A rural life well lived, is no doubt, the happiest of all, and the most healthful for soul and body. The words of the poet are golden truth,

> "Happy the man who hath escaped the town,
> Him did an angel bless, when he was born,"

and let it be part of our mission, so to teach.

Manual Labor.

Our charter requires manual labor of all the students. This is one of the distinctive features of the college and one that has elicited much comment. Learned men, connected with education in the ordinary mode, generally doubt the success of the experiment. Their doubts have arisen from the want of success of strictly manual labor schools, schools where the labor of the student was expected to be profitable and to pay in part, at least, his expenses.

Severe, long continued daily physical labor is, no doubt, inconsistent with the highest intellectual exertion. No man can regularly perform his eight or ten hours daily work in the field or workshop and devote five or six more to severe mental exercise.

It is certainly true, however, that two or three hours of moderate bodily exercise daily, whether in the gymnasium, in field sports and games, or in any labor which is not irksome, is for most persons, healthful, and promotive of mental energy.

Manual labor, at our college, is to be required, primarily, for the education of the student and not for profit, and the time devoted to labor should be graduated accordingly.

The object being education and not profit, the student should, so far as possible, be allowed to practise such labor as he does not understand, whereas in a school where profit is the object, each student should perform what he best knows already. We have carefully observed the working of this part of the system in the agricultural colleges of Michigan and Pennsylvania. The number of students in the former has been usually about 100, being as many as can be at present accommodated. The number at the latter has varied considerably, the catalogue for 1864-5 showing 146 students.

In each of them, three hours daily labor is required of every student. In the Michigan college, after detailing a sufficient number to take care of the stock, and to attend to various minor affairs, the students are divided into three equal classes, one of which works in the gardens, under the charge of the professor of botany and horticulture, while the other two work in the field under the professor of physiology and practical agriculture. At the end of a fortnight, the class from the garden is put into the field, and one of the other classes is put into the garden, new details having been made for the care of stock. A workshop is also provided, for which students are detailed as occasion requires.

The pupils are willing to work, and manifest great interest in the affairs of the farm and garden, taking a just pride in their fine stock and the excellent condition of their farm. Their farm contains nearly seven hundred acres of excellent land, covered, a few years since, with heavy timber. Upon it there are now about one hundred sheep and seventy cattle. They show good specimens of pure Shorthorn, Devon and Ayrshire cattle, of Southdown, Silesian and Spanish Merino sheep, and of Essex, Suffolk and Chester white swine. Interesting experiments are also going on with crosses of different breeds. Nearly all the labor is performed by the students, and every-

thing indicates that, thus far, the experiment of manual labor is entirely successful.

At the Agricultural College of Pennsylvania the time allotted to labor is the same. The labor is, however, performed under the farm superintendent, and not, as in Michigan, under the professors. Our visit there was at a time unfortunate for observing the working of the system. The death of Dr. Pugh, the former president, had left an interregnum, and Dr. Allen, the new president, was temporarily absent; and indeed had not been long enough in office to re-arrange affairs according to his own views. From what could be learned, it seemed that the relations between the students and farm superintendent were not entirely harmonious, and the work did not go on so pleasantly as could be desired.

It is important, we think, so far as possible, so to arrange our classes that the professors may superintend the students in their labors. It is hardly to be expected that we should be able to find any superintendent who will combine with the practical business tact and energy essential to his position, the scientific knowledge and habits of careful observation necessary to the prosecution of valuable experiments in agriculture, and the general culture which may command the respect of students.

This, however, is one of the many points which only experience and careful observation can determine. There are certainly manifest advantages in having the labor of the pupils directed by their professors, illustrating in the field the lessons of the lecture-room, and with the students, conducting to definite results experiments in the many vexed questions of practical agriculture.

Elective Courses.

It is a part of our plan to provide, at the college, for courses of study of shorter duration than the regular course, for the benefit of those who may desire only a practical education in agriculture. This has been undertaken in most modern institutions of learning, and may be effected by admitting pupils, under proper restrictions, to certain recitations in the regular classes, without requiring them to pursue all the studies of the class, and by providing courses of popular lectures, in the

leisure season of the year, which may be attended by the public generally.

It is believed to be practicable thus to meet the wants of two classes; the first, of those engaged in agriculture, of older growth than ordinary pupils, who have not time for a full course, who yet desire to prosecute, to some extent, scientific study, and to observe the improved processes of husbandry; the second, of educated young men, graduates of colleges and others, who wish to become familiar with the use of implements, with live stock, with farm labor and rural affairs in general, and to render practical their abstract knowledge of "such branches of learning as are related to agriculture."

Tuition.

It naturally occurs to many, that, inasmuch as this is a State institution, admission to it, as to our common schools, should be free, at least to our own citizens. To this it is answered, that a large annual expenditure is necessary to maintain such a college as our people demand, that one-half or more of the pupils will be abundantly able to pay a reasonable tuition fee, and that to give to such is no charity. Scholarships may be established, by State or private bounty, in aid of such as need assistance.

It is contemplated, too, in our plan, that students who desire to do so, upon previous notice given, may have their studies so arranged as to perform extra labor on the farm, for which they shall be paid.

By these, and other arrangements, it is hoped that no young man need be deterred from seeking an education at our college by want of pecuniary means.

The Farm.

Our favorable estimate of the farm selected, as to its general adaptation to the purposes of the institution, and as to its productiveness, are fully confirmed.

Most of the estate was leased for the past season under restrictions securing good husbandry, and requiring the tenents to expend all the hay and other fodder upon the land, and leave the manure for our use at the expiration of their leases. The rents secured for the year amount to more than $2,000, or

about five per cent. upon the whole purchase money, which, when we consider that we bought nearly four hundred acres of land in compact form, of persons who had no desire to sell, and for purposes other than mere profit, and that much of it is wood, rough pasture and swamp, indicates, at least, a judicious investment. In our purchase of D. K. Bangs, he deducted $125 from the price, for the rent of it the past season, so that that amount, to be accurate, should be added in our statement, to the rent of the farm for 1865. A part of the land purchased of Mr. Cobb, being the portion of the estate upon which it was expected improvements would first be made, was not leased. In the statement annexed to this Report, of the income and expenses of the farm, will be found various charges for labor in planting trees, fencing, ploughing, haying and harvesting, and credits for oats and hay, mostly relating to the Cobb land. Our operations in ornamental improvement of the grounds have necessarily been limited by want of the definite plans incident to the location of buildings and roads. They have consisted partly in planting a few hundred evergreens, of six to eight feet height, for a screen on our easterly line, and in setting, in nurseries, some three thousand small trees for future use. A reservoir upon the highest land where water appears, has been constructed, ten feet in diameter and ten feet deep, which has been full for many weeks, with a pipe laid low enough to draw it to the bottom. It was deemed important early to test the supply of water from the springs, and the one in question, two hundred and twenty-five feet above the lowest point on the estate, although not at any time a copious spring, has been found to yield five hundred gallons per day in the dryest part of the very dry summer of 1865. Abundant supplies of water from springs coming out at lower points, yet elevated enough for all farm purposes, are found in various places on the farm.

Alteration of Highway.

A public highway crosses the estate, leaving about one-quarter of its territory on the upper, or east side, and the rest on the west or lower side. As this highway admitted of obvious improvements which were likely to be made at some time, measures were taken, early in the season, to have its location changed so as better to accommodate both our estate

and the public. Upon a petition filed for the purpose, it was, on the first Tuesday of December, adjudged by the county commissioners, that the common convenience and necessity require a change therein, and the 17th day of January, 1866, has been fixed by them, for the proper location thereof.

BUILDINGS.

At the quarterly meeting in February, a committee was appointed to consider the subject of location and plan of construction of buildings. Upon approaching this duty it was at once seen by the committee that no satisfactory conclusions could be reached without a careful and elaborate survey. Our engineer was therefore instructed to make such a survey, and the result is a map showing accurately every building, fence, road stream, spring and other principal object on the estate, with sketches of the tracts of forest, and contour-lines at every five feet vertical height, so marked that at a glance the elevation of any point may be accurately observed. When it is understood that the surface is quite diversified with hills and valleys, woods and fields, varying at points, two hundred and seventy feet in height, the necessity of such a survey will be appreciated. It is not only of use in the location of buildings; but in every future improvement, whether of the construction of buildings, roads or walks, of works for supplying water to the different parts of the estate, of draining, irrigation or grading, such a map is essential to systematic progress.

Having completed our surveys and obtained all possible information respecting the size and form of a college building, a competent architect was employed to furnish specific plans and superintend the erection of such a building.

After a free interchange of opinion, and a full discussion, the site deemed by the trustees most suitable has been selected, and preparations have been made for procuring materials for the proposed building. The general expectation of a decline in the prices of labor and materials has induced us to delay as long as possible the contracts for its erection. It is hoped, however, that energetic progress may be made in the opening of the coming season.

It is more important to organize the institution wisely than rapidly, and to any reasonable delay which brings harmony to

our counsels, and inspires confidence in our final action, we may cheerfully submit. We are bound, however, by the conditions of the grant of Congress, to provide such a college as is therein described, within five years from the second day of July, 1862.

Hoping for the prompt co-operation of the governor and council in establishing our plan of organization, and for such aid from the legislature as may be necessary for its development; expecting from all that charity which is due to men charged with an enterprise in which the interests of agriculture and education, and the reputation of the Commonwealth as the pioneer in education, are alike involved, we trust we shall be able to lay the foundations of our institution so broad and deep, that it may forever stand as a landmark of progress in the education of the people.

Financial.

By Act of July 2, 1862, Congress granted to the Commonwealth, scrip for 360,000 acres of land for colleges for the benefit of agriculture and the mechanic arts. Our legislature, by Act of April 27, 1863, appropriated one-third of the income of the fund derived from the sale of nine-tenths of the scrip to the Institute of Technology, one-tenth having been assigned to the Agricultural College to be used in payment for its farm. Our report of last year states the sales of the scrip to the close of the year 1864. Since then the agent of the college has sold of the one-tenth 960 acres for $736, and the commissioner for the State has sold 4,960 acres for $4,144.80.

The results of all the sales to the close of the year 1865 are as follows: Of the tenth of the scrip assigned to the college, 32,320 acres have been sold for $27,318.40, and 3,680 acres remain unsold. Of the other nine-tenths, 104,160 acres have been sold for $83,546.40, and 219,840 acres remain unsold. In all, 136,480 acres have been sold for $110,864.80, being an average of about 81¼ cents per acre.

The proceeds of the one-tenth are accounted for by the treasurer of the college, and the proceeds of the nine-tenths by the treasurer of the Commonwealth.

The governor and council having fixed the minimum price of the scrip in the hands of the commissioner at eighty cents

per acre, which is somewhat above its market value during the past year, the sales have been small. It is believed that the legislature would prefer to advance the funds necessary to the maintenance of the college, rather than force the sale of the scrip at a low price.

By Act of May 11, 1864, the legislature granted $10,000 "to defray the necessary expenses of establishing and maintaining" the college, and provided for the repayment thereof out of the first moneys received by the treasurer of the Commonwealth as income of our part of the land scrip fund.

In our annual report of last year we set forth reasons why this repayment cannot be legally made, and referring to those reasons we again respectfully ask the legislature to repeal the provision for such repayment.

By Act of May 11, 1865, the sum of $10,000 was granted to the Massachusetts Agricultural College to aid in its establishment. The accounts of the treasurer of the corporation, herewith exhibited, show the application of these funds so far as expended. The treasurer of the Commonwealth reports that the income of the scrip fund for the years 1864 and 1865 is $11,365.22, two-thirds of which, $7,576.81, is held by him for payment of the $10,000 granted to the college in 1864, the other third to be accounted for to the Institute of Technology.

The apparent income of the scrip fund has been increased by a re-investment of part of the fund originally in gold-paying bonds, in 7-30's, and by large premiums on gold received as interest. It has been suggested by the incoming treasurer that a part, $2,900.70, of what has been regarded as income, might perhaps be properly treated as principal, so as to preserve the integrity of the fund, as the Act of Congress requires. This correction, if made, must be made by adding to the principal a part of future income.

The treasurer's account shows the sum of $1,255.38 advanced for expenses of the trustees. This covers their expenses from May, 1864, to the close of 1865. For the year ending May, 1864, there was provision made in the appropriation bills by the legislature. For the following year, a similar appropriation was inserted by the proper committee, but it was by some misapprehension stricken out.

Our annual meeting being held in May, we have heretofore made up our accounts to that time. It has been thought better, however, to conform to the political year of the Commonwealth, and to make up our accounts in future to the first Wednesday of the year. As there is no fund, except such as the legislature may provide, to which the expenses of the meetings of the trustees can be charged, it is hoped that such expenses may go regularly into the appropriation bills, like those of other State institutions. Of the $2,000, which by the treasurer's account appear to have been paid to the building committee, there has been expended, principally in quarrying and drawing stone and in excavation, $1,431.41, leaving $586.59 on hand. The item "paid H. F. French per order of trustees $500," was a payment to the executive committee to be applied to general improvements. Of this amount $163.76 has been expended in constructing a reservoir, and the balance $336.24 is on hand.

A general statement of the financial condition of the college, a statement of the income and expenditures of the farm, and the accounts of the treasurer, are annexed and form part of this Report.

Respectfully submitted in behalf of the Trustees by

HENRY F. FRENCH, *President.*

STATEMENT OF PROPERTY AND DEBTS.

1. As to Land.

Property.	—310½ acres and buildings cost .	$34,999 50
	Land-scrip for 3,680 acres at 80c., .	2,944 00
	In hands of treasurer, . . .	5,929 31
		$43,072 81
Debt.	—Note to L. D. Cowles, ...	$12,000 00
	Balance	31,072 81
		$43,072 81

2. As to Building Fund.

Property.	—Amount of unpaid subscription .	$70,000 00
	One year's interest, ...	4,200 00
	In hands of treasurer, . . .	3,210 00
	In hands of committee, . .	586 59
	Quarried stone and tools, say .	1,000 00
		$78,996 59

3. As to Contingent Fund.

Property.—In hands of treasurer, ... $13,665 05

4. As to Fund for Maintenance of the College.

Property.—Two-thirds the income of $83,453.00, held by the treasurer of the Commonwealth. Income for 1865 and probable income for 1866, held to pay $10,000 appropriation of 1864.

Two-thirds the income of 219,840 acres of land-scrip yet unsold, valued at eighty cents per acre, or $175,872.00.

STATEMENT OF INCOME AND EXPENDITURES OF THE COLLEGE FARM, IN 1865.

Receipts.		*Expenditures.*	
Rent of L. D. Cowles, . .	$900 00	Donahue, labor, ...	$15 50
of Chester Cowles, .	580 00	Chester Cowles, labor, . .	146 50
of Crouch place, . .	200 00	L. D. Cowles, labor, . .	96 50
of Donahue, . . .	125 00	D. K. Bangs, labor, . . .	21 00
of Cobb pasture, . .	75 00	Cutler, grass seed, &c., . .	139 64
150 bushels oats, . . .	90 00	Insurance, ...	32 00
10 tons hay, ...	160 00	Trees, ...	53 10
		Reservoir, ...	163 76
	$2,130 00		$668 00

Note.—The rents as stated above are for the year ending April 1, 1866, when the last half of these amounts are payable. The first three items for labor were offset against the rent, so that the treasurer's accounts show only the balances for the half year. The oats and hay are on hand.

DR. NATHAN DURFEE, *Treasurer, in account with* MASSACHUSETTS AGRICULTURAL COLLEGE. CR.

LAND SCRIP ACCOUNT.

1864.			1864.		
Aug. 3,	To H. F. French, scrip sold,	$20,000 00	Oct. 14,	By paid Henry Cobb, land,	$6,409 50
Sept. 6,	H. F. French, scrip sold,	5,000 00	Nov. 4,	John Donahue, land,	2,170 00
1865.			4,	D. R. Bangs, land,	2,000 00
Jan. 17,	H. F. French, scrip sold,	1,500 00	12,	Chester Cowles, land,	3,660 00
May 3,	H. F. French, scrip sold,	82 40	1865.		
11,	H. F. French, scrip sold,	256 00	Jan. 2,	J. S. Crouch, land,	2,760 00
Nov. 1,	H. F. French, scrip sold,	240 00	April 12,	L. D. Cowles, land,	6,000 00
Dec. 27,	H. F. French, scrip sold,	240 00	1866.		
	Interest $20,000 loaned to State,	810 41	Jan. 3,	balance on hand,	5,129 31
		$28,128 81			$28,128 81

There is now outstanding a note to L. D. Cowles for $12,000 with interest from November 25, 1865.

BUILDING FUND.

1865.			1865.		
Sept. 15,	To received of William Kellogg, subscription for Town of Amherst,	$5,210 00	Oct. 13,	By paid Building Committee,	$2,000 00
			1866.		
			Jan. 3,	balance on hand,	3,210 00
		$5,210 00			$5,210 00

CONTINGENT FUND.

1864.			1864.		
July –,	To State appropriation,	$2,500 00	Nov. 21,	By blank book,	$1 50
Sept. –,	State appropriation,	2,500 00	1865.		
1865.			Jan. 17,	Surveying, Shedd & Edson,	548 22
Feb. 11,	State appropriation,	2,500 00	29,	W. & G. Cutler, grass, seed, &c.,	139 64

Mar. 6,	To State appropriation,	$2,500 00	Oct. 13,	By H. F. French, per order Trustees,		$500 00
23,	State appropriation,	10,000 00	18,	Surveying, J. H. Shedd,		300 00
Nov. 9,	Interest, $2,500, loaned,	55 42	Nov. 25,	Interest paid L. D. Cowles,		858 00
Dec. 27,	Sundry rents,	502 03	1866.			
			Jan. 1,	Salary of President,		3,000 00
				Expenses of Trustees, sundry times,—		
				Charles G. Davis,	$54 00	
				Carriage hire,	19 50	
				Amherst Hotel,	29 00	
				Henry L. Whiting,	97 35	
				Henry L. Whiting,	102 05	
				Paoli Lathrop,	82 00	
				Paoli Lathrop,	55 90	
				P. Stedman,	73 50	
				P. Stedman,	41 30	
				H. Colt,	153 10	
				H. Colt,	79 90	
				Allen W. Dodge,	10 20	
				Allen W. Dodge,	16 00	
				Charles O. Sewall,	13 65	
				Charles O. Sewall	19 70	
				George Marston,	42 55	
				Charles L. Flint,	16 10	
				W. B. Washburn,	39 50	
				W. B. Washburn,	12 30	
				J. L. Fairbanks,	14 10	
				Nathan Durfee,	94 11	
				J. W. Lincoln,	19 55	
				H. F. French,	105 50	
				George Marston,	33 55	
				J. White,	30 97	
						1,255 38
				D. K. Bangs, trees, &c,		21 00
				Paid H. F. French, sundry bills,—		
				Wells & Co., trees,	$26 33	
				Repairs of office,	32 25	
	Amount carried forward,	$20,557 45		Amounts carried forward,	$58 58	$0,000 00

DR. NATHAN DURFEE, *Treasurer, in account with* MASSACHUSETTS AGRICULTURAL COLLEGE—*Continued.* CR.

	Amount brought forward,	$20,557 45		Amounts brought forward,	$58 58	$0,000 00
				By paid H. F. French, sundry bills,—		
				Wood and sawing,	8 25	
				Stationery,	9 50	
				Paper and printing,	13 00	
				Freight, trees,	2 11	
				Stamps,	2 00	
				Labor,	4 54	
						97 98
			1865. May 3,	Stamps,	$60 25	
				Insurance,	32 00	
				Letter book, &c.,	15 37	
				Printing,	6 75	
				Trees,	24 66	
				College seal,	8 00	
				Telegraph,	1 44	
				Mr. Hollis,	10 00	
				Recording deeds,	6 71	
				Copies and labor,	5 50	
						170 68
				By balance,		13,665 05
		$20,557 45				$20,557 45
1866. Jan. 3,	Total receipts from all sources to date,	$53,896 26	1866. Jan. 3,	Total expenditures to date,		$31,891 90
				Balance in hands of Treasurer this day,		22,004 36
		$53,896 26				$53,896 26

Respectfully submitted.

NATHAN DURFEE,
Treasurer Massachusetts Agricultural College.

SENATE...... ......No. 39.

ANNUAL REPORT

OF THE

TRUSTEES

OF THE

Massachusetts Agricultural College.

1867.

BOSTON:
WRIGHT & POTTER, STATE PRINTERS,
No. 4 Spring Lane.
1867.

ANNUAL REPORT.

To the Senate and House of Representatives in General Court convened.

In accordance with the requirement of the Act incorporating the Massachusetts Agricultural College, that "the corporation shall make an Annual Report of its condition, financial and otherwise, to the legislature," the Board of Trustees submit the following

REPORT:

The Annual Reports of 1865 and 1866 set forth with sufficient fulness the organization and general plan of the Agricultural College.

The governor of the Commonwealth, the secretary of the Board of Agriculture, secretary of the Board of Education, and the president of the College, are *ex officio* members of the Board of Trustees.

The remaining members of the Board are Marshall P. Wilder, of Dorchester; Charles G. Davis, of Plymouth; Nathan Durfee, of Fall River; Henry Colt, of Pittsfield; Charles C. Sewall, of Medfield; Paoli Lathrop, of South Hadley; Phineas Stedman, of Chicopee; Allen W. Dodge, of Hamilton; George Marston, of Barnstable; William B. Washburn, of Greenfield; Henry L. Whiting, of Tisbury; D. Waldo Lincoln, of Worcester; Henry F. Hills, of Amherst; E. Francis Bowditch, of Framingham.

On the 29th of September, President French resigned his office, and Professor P. A. Chadbourne, of Williams College, was, on the 7th of November, elected in his place.

The time has now come when it seems demanded that a definite plan of action should be presented to the legislature, not only to meet the requirements of the law, but also that those who desire the advantages of the College may understand the facilities it will offer for education.

Plan of Study.

According to the regulations already adopted for admission to the freshman class, students must be prepared to pass the examination required for entering the normal schools of the State.

The subjects required to be taught in the College were also given in a former report. The present plan, therefore, simply arranges the studies, giving to each what is thought to be its proper place in the course. Undoubtedly, experience will suggest improvements, changing the relative place of studies here mentioned, introducing others, and perhaps striking out some now required. The object aimed at in the instruction is, first, to make intelligent, thoroughly-educated men; and secondly, to make practical agriculturists. This is demanded by the law of Congress donating the lands, which declares the purpose to be, "*to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life.*" It is difficult to see how an agricultural education alone would meet the requirements of this law if such an education were desirable. But any system that attempts to give practical knowledge without first having given a broad scientific basis, will succeed only in making skilful artisans, and will not send forth men fitted to improve themselves, or add materially to the advancement of knowledge.

The course of instruction is necessarily somewhat modified by the condition of our schools. If all the children in the State could have the advantage of our best High Schools, the studies of the College course might commence one year in advance of what they now can. The College must raise its standard just as rapidly as it can be done without shutting out those who most need its advantages.

If any are now able to have at home the advantages offered by the College in the first year, such students can enter in advance, while the College should offer instruction to those who

must go from home, at a less price than it can be obtained for in any other place.

It is proposed that, for the present at least, the instruction shall consist of two courses: a special course of lectures, exclusively agricultural, to be given every winter, and also a regular four years' course of study that shall give a truly liberal education,—a basis for the active duties of life, which any citizen of a free republic may be called upon to engage in. The College will thus offer the advantages of a professional school in agriculture, and an educational course differing from that in the other colleges of the State, but no less extensive and thorough in its requirements.

Instruction in the regular course must first be given mainly by permanent professors of the College; but in the special courses, it is intended to bring in as lecturers gentlemen connected with other institutions, who have made certain subjects connected with agriculture their special study; and also to bring in prominent agriculturists to lecture upon those subjects that have been of special interest to them. The College will thus bring before its students the best instruction that can be given by scientific men and the practical agriculturists of the State. We need all the aid we can command in such a new and almost untried enterprise as this, and we know of no better way to secure it than this which we have indicated. We see no better way than this to secure the practical element which it is desirable to have prominent in the instruction of the College; and in no way can abstract science be more rapidly advanced than where the suggestions which have come from study in the laboratory and cabinet can be tested at once by the observations and experiments of practical men, who are thus enabled to turn to good account the accumulated experience of a lifetime, which otherwise might be of no advantage to others. The first work of the College in aid of agriculture will be to put in practice the best results which have already been worked out by our leading agriculturists, before it will be in a condition to enter upon new experiments.

The following is the course of study proposed for both the regular and special departments. Such explanations are added as will show as nearly as can now be done what the work of each year is to be.

1. Special Course.

Lectures commencing with the Spring Term, embracing in part the following subjects:—

Structural Botany, Propagation and Cultivation of Plants, History of Cultivated Plants, Pomology, Practical Agriculture, Agricultural Chemistry, Physical Geography and Surface Geology, Natural History of Domestic Animals, Comparative Anatomy, Diseases of Animals, Milch Cows and Dairy, Sheep Husbandry, Insects injurious to Vegetation, Fuel—its origin and preparation, Rural Architecture.

A portion of these lectures will be delivered by the president and professors of the College. But among those who have promised their aid in carrying on this course are Hon. Marshall P. Wilder, Dr. George B. Loring, E. W. Bull, Esq. and C. L. Flint, secretary of the Board of Agriculture.

This course of lectures will be especially for the benefit of those whose circumstances are such that they can devote but a short time in winter to study. It is but extending and rendering more complete the plan of the Board of Agriculture, in holding yearly meetings for lectures and discussions. While these lectures will not take the place of the regular college duties, the arrangement of the lectures and college studies will be such that students who remain three years in College, will be able to hear all the lectures of the special course.

2. Regular Course.

Freshman Year.

First Term.—Algebra; English Language; Human Anatomy; Botany. Lectures on the Preservation of Health and Methods of Study.

Second Term.—Geometry; Drawing; French; General Chemistry and Mineralogy. (Recitations and Lectures.)

Third Term.—Geometry; Drawing; French; General Zoölogy; Botanical Analysis.

Members of the Freshman Class will be allowed to attend at least one lecture daily of the special course on Agriculture, in such departments as the Faculty shall determine.

Sophomore Year.

First Term.—Trigonometry; Surveying; Mensuration; Agriculture; Physical Geography; Applied Chemistry and Mineralogy. (Recitations and Lectures.)

Second Term.—Analytical Geometry; German; History. Farm Management by lectures; Book-keeping and Farm Accounts; Laboratory Practice.

Third Term.—German; Comparative Anatomy; General Geology; Landscape Gardening and Rural Architecture.

Lectures.—Diseases of Domestic Animals; Physical Properties of Soils; Drainage.

Students of the Sophomore Class will be allowed to attend one lecture daily of the special course, on such subjects as the Faculty may determine.

Junior Year.

First Term.—Mechanics and Optics; Political Economy; English, French or German Literature or Calculus, (optional.)

Lectures.—Horticulture; History of Useful Plants.

Second Term.—Engineering; Hydrostatics; Analytical Chemistry, Laboratory Practice; Forestry; Industrial Statistics.

Lectures.—Magnetism and Electricity.

Third Term.—Astronomy, Climatology; Animal and Vegetable Physiology, with special reference to Breeds and Varieties; Rhetoric; Laboratory Practice.

Lectures.—Entomology, Bee Culture, &c.

Students in the Junior Class will have the privilege of attending one lecture daily, of the special course, on such subjects as the Faculty shall determine.

Senior Year.

First Term.—Civil Polity; Intellectual Philosophy; Economic Geology and Mining.

Lectures.—Law relating to Rural Affairs.

Second Term.—Moral Philosophy; Logic; Æsthetics; English Literature.

Lectures.—Architecture.

Third Term.—Special Subjects; Reviews.

Seniors attend any lectures of the course.

Military Tactics; Declamations; Discussion and Themes during the whole course.

The first term of the College will commence October 2, 1867. The first year provision will be made for a freshman class only.

Those students who complete the whole course will be entitled to the degree of Bachelor of Science; and those students who make special proficiency in any department, beyond what is required in the college course, without neglecting the required duties, will, on examination, be entitled to a special diploma in that department.

Persons not proposing to graduate may enter at any time and select any two studies which they are fitted to pursue, and attend any lectures of the course. Such students must conform to all the college regulations binding upon students of the regular course.

The laboratory and field practice will be under the direction of the professors of the several departments, and will be carried on for the purpose of instruction alone. No natural science can be learned by the mere study of books. There must be work in the laboratory, in the cabinet and in the field. This principle now recognized in most of our colleges and scientific schools, will be made prominent in all the departments of this College. A well cultivated farm will at all times furnish illustrations in Agriculture. A botanic garden, with green-house, graperies and propagating houses will be an invaluable aid in the study of Botany and Horticulture.

College Buildings.

A college must have recitation and lecture rooms convenient for the purposes of instruction, and when a college is fully organized no small amount of accommodation is required for cabinets, library and other appliances required in giving a thorough education. Some provision must also be made for rooms and board for students. When students can be accommodated in families, that is the best that can be done for them. But this method of rooming and boarding is always expensive, and if an Agricultural College is situated so as to have a large farm connected with it, there will seldom be found families enough within a reasonable distance to furnish rooms and board for students at such prices as they can afford to pay. Certainly, as this College is located, there seems to be an imperative demand that some provision should be made for the students, both on the score of convenience and economy. Because students are

better off in families than in any other place, it does not follow that they are better off distributed in small club houses where there are no families, than they are in a college building of the ordinary kind. The Trustees must furnish the best accommodation possible with the means at their command.

In the plan adopted they have contracted for such buildings as will always be needed for the College. And while these buildings are by no means all that will ultimately be required for the greatest efficiency of the institution, they will be sufficient for its accommodation, until it shall be better known than it now is, exactly what is needed, and until the College shall be shown to be worthy of the patronage and support of the public.

The following buildings are already contracted for at the prices named, the work to be completed by the first of August of the present year.

1. A dormitory 100×50 feet, four stories high. The three upper stories of this building will afford ample rooms for forty-eight students, leaving the entire lower story for recitation rooms, a cabinet and library room. Whenever a building shall be erected giving more ample accommodations for lectures, recitations, cabinets and libraries, this lower story can readily be used for students' rooms. The cost of this building, according to contract, is to be $30,000.

2. A laboratory 46×57 feet, two stories high. The lower story contains a room for chemical analysis, with furnace room, apparatus room, and balance room attached. The upper story contains furnace room, three apparatus rooms, and a large lecture room which can also be used as a chapel. Cost, $9,350.

3. A boarding house, where board can be furnished for fifty students. Students will board wherever they choose, but this house is built for the purpose of securing to such as desire it, board at cost within a convenient distance to the College. Cost of the building, $5,050.

It is estimated that $46,000 will cover the entire cost of these buildings and such out-buildings as are required for them.

This will leave $33,429.34 of the building fund for repairing the buildings now on the farm, erecting new farm buildings and a president's house.

INSTRUCTION.

Some account has already been given of the proposed method of giving instruction in the special course.

In the regular course, the College must commence with a single class, and at first will have no need of a full corps of instructors. The instruction in chemistry and natural history for the first year will be given by the president. For the other departments ample provision will be made before the opening of the collegiate year.

The Hon. Levi Stockbridge has been elected Farm Superintendent and will enter upon the duties of his office the coming spring. The farm will then, as soon as possible, be brought into a state fitting it for the purposes of instruction in practical agriculture. In addition to such field work as may be required under the direction of the several professors for the purpose of instruction, those students who choose to employ a portion of their time on the farm will be encouraged to do so under the direction of the Farm Superintendent. For such labor a fair compensation will be given. But as the purpose of the College is instruction, mere labor for pay will not be encouraged or allowed to such an extent as to interfere with the regular and successful performance of all required college duties.

BOTANIC GARDEN.

With the limited means derived from the college fund, no outlay on the land could be made except such as should be demanded for the general cultivation of the farm. But the Trustees are able to make the gratifying announcement that $20,000 have already been pledged to the College for the express purpose of establishing and maintaining a Botanic Garden. Ten thousand dollars of this fund are given by Messrs. Leonard M. and Henry F. Hills, of Amherst, and ten thousand by Dr. Nathan Durfee, of Fall River. These liberal subscriptions, so promptly made for this purpose, render it the duty of the Trustees at once to undertake the work on a scale that shall correspond to the generous intentions of the donors, and make the garden an honor to the State. We have no doubt others will willingly aid in carrying out a plan that shall secure to the College all that can be desired in this direction. The

whole subject has been referred to a committee of the Board, to report upon a plan of organization, so that the work of preparing the ground for the garden may be commenced the coming spring.

Relations to Amherst College.

The people of Massachusetts, through their representatives, were emphatic in their decision that the Agricultural College should not be merely a department of some already existing institution. A fear has been entertained by some that its location near another college is an unfortunate one. We think any apprehension on this score is entirely without foundation. Certainly there are some great advantages in its proximity to an old established institution. The very liberal offers made by Amherst College in regard to the use of its library, give the students of the Agricultural College advantages which they could not have for many years from the institution itself. The very extensive and valuable mineralogical and geological cabinets there will always be open to our students, so that there will be no need of attempting to build up such cabinets in connection with the Agricultural College. With these cabinets so near and so valuable—but valuable to students only for general examination—it would be a mere waste of money to do more than to prepare cabinets for illustration in the lecture room, and make collections in those departments having special reference to agriculture. This method of action ought to be more generally adopted than it is, even by those colleges far from each other. If each one would provide itself with specimens needful for class instruction, and then complete its collection in some department not well represented in other cabinets, we should have far better results for science than we do when each institution strives to build up its cabinets in all directions without any reference to what can be found in a neighboring institution ; or, if it has any reference, it is simply to duplicate the specimen instead of supplementing it. It is not too much to hope that the day will come, when for certain purposes, all the institutions of the State will be bound together in a university system, so that each may do its appropriate work and avail itself of the work done by other institutions, whether

near or far from it. We have no doubt there will yet be much greater concert of action among our institutions, even without change of location. Whatever disadvantages may be alleged from the location of the Agricultural College, it certainly has great advantages from its nearness to another institution which has around it expensive libraries and cabinets which need not be duplicated. In time a full return will be made to Amherst College in the Botanic Garden and other facilities for certain scientific studies which it is now in no position to command for itself.

While it is highly desirable and expected that the Agricultural College shall have its own corps of professors devoted to its work, it is not easy to select at any time a body of men fitted at once for the several departments. And, especially in the beginning, the full amount of labor in some professorships will not be required. In some departments only a small amount of time is ever required in a single year. It will not be merely a matter of economy, but an advantage to the institution in other respects, for us to be able to avail ourselves to some extent of the services of gentlemen connected with the other college. It is easy to see that the two institutions may be of mutual benefit to each other, while each goes on performing its distinct work.

Cost of Education.

It is the policy of Massachusetts to bring education within the reach of all. This may be said to be the aim of our American college system. The best colleges receive from their students only a small part of the money which is annually expended for their benefit. Grants from the State and donations from liberal benefactors have put our colleges into such a position that they can offer to the poorest, for a mere nominal sum, such advantages that no favored class in the land can secure better.

Every year are found in them, struggling side by side, the sons of the rich and the poor. This is as it should be, and shows our colleges to be truly democratic institutions. But the support of the student while obtaining his education has become so expensive within the last few years, that it is to be

feared that a large class of most worthy young men will be deterred from undertaking an extended course of study. It is the desire of the Trustees to do everything in their power to diminish the expenses of the students who may become connected with the Agricultural College. For the present the price of tuition is fixed at thirty-six dollars a year, and room rent in the college building at fifteen dollars. Board in the club-house will be furnished at its actual cost, reckoning nothing for rent of building. It would be desirable for still further provision to be made to diminish expense. This can be done by the establishment of scholarships and by donations for founding professorships, and other purposes. It would be very appropriate for every agricultural society in the State to have at least one scholarship at its disposal, to be awarded by examination of applicants for the place. The candidates might be restricted to those who proposed to devote themselves to agricultural pursuits within the limits of the society. It might be the means of saving to us as agriculturists some of the young men who would otherwise leave the State. It would secure to each section of the State a few thoroughly educated farmers, who could not fail to exert a beneficial iufluence on the farming interest of their portion of the State. They would be able also to render important assistance to the College and to the Board in making experiments and recording reliable observations in the different counties, thus bringing out results which could not possibly be reached by experiment in any one portion of the State. We can hardly think of a more honorable and inviting field of labor, than those young men will occupy who thus fit themselves to become leaders in developing this great interest, either as practical farmers, or as teachers in the agricultural schools and colleges which are springing up in almost every State.

And before our College has a body of alumni to care for its interests, we must look mainly to the Board of Agriculture, by which the College ought to be " connected with every farm in the State." With no special effort, every agricultural society in the State might in a single year, secure a scholarship for itself, and do so much towards permanently diminishing the cost of education for a student of its own choice.

Financial.

An account of the expenses of the institution will be found in the Treasurer's Report, and the general condition of the funds for building and support of the College is presented in the schedule appended to this Report. The Trustees will be called upon to be pay $600 towards the expense of the new county road just completed through the College grounds. There are also a few other unadjusted accounts of small amount.

The treasurer of the Commonwealth reports the whole amount received by him from sale of land scrip to be $83,673.00. From the income of the funds in his hands $4,408.20 have been taken to pay premium on stocks bought, that the principal might remain undiminished. Of the net income of the land-scrip fund the College is entitled to two-thirds and the Institute of Technology to one-third. The net amount of income remaining in the treasury to the credit of the College at the close of the year 1866, was $8,935.03.

But by the provisions of the Act of May 11, 1864, granting $10,000 to the College, this sum was to be repaid to the Commonwealth from the income of the land-scrip fund belonging to the College. If the provisions of that Act are insisted upon by the Commonwealth, it will absorb all of the income of the fund belonging to the College for 1864, 1865, 1866 and $1,064.97 of the income of 1867. The reasons why this repayment cannot legally be made have been fully set forth in former reports. The attention of the legislature is again respectfully called to this subject.

The whole amount of scrip granted to the Commonwealth was 360,000 acres. One-tenth (36,000 acres) has been sold for $29,778.40, and that sum has been paid to the treasurer of the College for the purchase of land. Of the remaining nine-tenths 219,520 acres remain unsold.

Conclusion.

It is unfortunate for the College that its organization has been so long delayed. Difference of opinion in regard to location of the buildings has been misunderstood as a difference of opinion in regard to the method of organizing and conducting the institution. Undoubtedly there is a difference of opinion

as to what the College should be. In reference to some of our best institutions that have been established for more than a century, there is a marked difference of opinion among their alumni and officers as to the most desirable organization for them now to meet the demands of the present time. As no one can claim to have experience in conducting such an institution as this, it would seem to be the wisest way for all well-wishers of the College to go on as best they can in the light of experience gained in the general work of education, and be ready to adopt such changes as the practical working of the institution shall show to be necessary.

The fear is expressed by some that, if an attempt is made to give a truly liberal education, the students will turn aside from agriculture to other pursuits. Undoubtedly some of them will. If such an education is given in practical science as ought to be given in such an institution, there will be a demand for its students as teachers and in other professions. And it would be an education entirely unworthy of Massachusetts, and contrary to the plain intent of the Act of Congress donating the land, if it were so meagre in its requirements that the students should be fitted only for one pursuit in life. No surer way could be devised to defeat the very end for which the College was established, than to conduct it on a plan which proclaimed in theory and practice, that its students were to be kept in ignorance of certain things lest they should be above their calling. No institution can ever succeed on such a plan, and it ought not. It is difficult to see what a student would enter such an institution for. Such views are repugnant to every generous feeling which an educated man ought to possess, contrary to the principles of our institutions, and are not sustained by the present position of the agriculturists of this State. The adoption of such a system would be simply saying to the farmers of Massachusetts that they are tillers of the soil, because they are too ignorant for other pursuits. An entirely different principle has been acted upon in organizing the College. While the student is to be educated, agriculture, which rests upon a knowledge of all the natural sciences, is to be made a means of education. It ought to be so presented that it shall be an inviting pursuit for an educated man. When all its processes are scientifically under-

stood, it will be difficult to point to any business or profession that offers a field of thought more desirable. The number of students will undoubtedly be small until the true position of the College is fully understood and it has established its character by the work it has accomplished.

The College will accomplish its design only by giving a sound education to its students and by aiding in the work undertaken by the Board of Agriculture, of developing the sciences of Agriculture and Horticulture in the State.

Respectfully submitted.

By order of the Trustees,

P. A. CHADBOURNE, *President.*

STATEMENT OF PROPERTY AND DEBTS.

1. *Land.*

Property.—310½ acres of land with buildings, . . .	$34,999 50
In hands of treasurer, ...	5,889 31
	$40,888 81
Debt.—Note to L. D. Cowles, ...	$11,000 00
Balance, ...	29,888 81
	$40,888 81

2. *As to Building Fund.*

Amount of unpaid subscription, ...	$70,000 00
Interest on $50,000 to January 1, 1867, ...	4,875 00
In hands of treasurer, ...	210 00
Quarried stone and tools, say, ...	1,000 00
Brick and lumber, say, ...	2,000 00
Due from contingent Fund, ...	1,344 34
	$79,429 34

3. *As to Contingent Fund.*

Property.—In hands of treasurer, ...	$7,354 43
Debt.—Due building fund as above, ...	1,344 34
	$6,010 09

4. *As to Fund for Maintenance of the College.*

Property.—Two-thirds of the income of $83,453, held by the treasurer of the Commonwealth.

Income of 1864, 1865, 1866, and part of income of 1867, held to pay appropriation made by legislature in 1864.

Two-thirds of income of land scrip, 219,520 acres yet unsold.

Income of $10,000 for support of Botanic Garden, given by L. M. and Henry F. Hills.

Income of $10,000 for Botanic Garden, given by Nathan Durfee.

TREASURER'S REPORT.

Dr. MASSACHUSETTS AGRICULTURAL COLLEGE *in account with* NATHAN DURFEE, *Treasurer.* Cr.

LAND SCRIP ACCOUNT.

1866.			**1866.**		
June 26,	To paid L. D. Cowles on account of land,	$1,000 00	Jan. 18,	By balance on hand,	$5,129 31
Dec. 1,	L. D. Cowles interest on note,	700 00	July 5,	cash sale of scrip,	2,460 00
1867.					
Jan. 21,	balance to new account,	5,889 31			
		$7,589 31			$7,589 31
			1867.		
			Jan. 21,	balance cash on hand,	5,889 31

BUILDING FUND.

1866.			**1866.**		
Aug. 1,	To cash paid H. F. Hills, Treasurer,	$2,000 00	Jan. 18,	By balance on hand,	$3,210 00
Nov. 20,	H. F. Hills, Treasurer,	1,000 00			
1867.					
Jan. 21,	balance to new account,	210 00			
		$3,210 00			$3,210 00
			1867.		
			Jan. 21,	balance on hand,	210 00

CONTINGENT FUND.

1866.		
Jan. 18,	To cash paid H. F. Hills, (Trustee,)	$17 00
Feb. 2,	Olmsted, Vaux & Co.'s bill,	275 00
2,	J. H. Shedd's bill,	473 61
Mar. 5,	J. H. Richards' bill,	500 00
26,	H. F. Hills for quarry,	500 00
Apr. 2,	H. F. French, one quarter salary,	750 00
May 2,	J. L. Fairbanks' bill,	11 25
2,	D. W. Lincoln, (Trustee,)	125 00
June 8,	Belcher & Taylor, bill,	30 50
8,	J. Nourse, agent, bill,	18 15
29,	W. & G. Cutler, bill,	68 06
July 2,	H. F. French, one quarter salary,	750 00
Oct. 1,	H. F. French, one quarter salary,	750 00
1,	F. L. Olmstead, bill,	275 00
1,	J. R. Richards, bill,	500 00
4,	W. S. Westcott, bill,	89 43
4,	James Kellogg, bill,	54 66
4,	J. Adams & Son, bill,	35 00
5,	Benjamin H. Bliss, bill,	60 00
5,	Ames Plow Co., bill,	80 75
12,	J. J. Walworth's bill,	52 79
12,	J. Bradley, bill,	33 45
16,	W. H. Gilmore, bill,	280 00
Nov. 9,	H. F. French, bill,	257 13
9,	H. F. French, bill,	419 70
9,	Paoli Lathrop, bill,	347 00
	Amount carried forward,	$0,000 00

1866.		
Jan. 18,	By balance on hand,	$13,665 05
Feb. 2,	cash interest on loan,	221 66
July 7,	rent of J. S. Crouch,	100 00
13,	sale of grass,	40 00
24,	rent of Chester Cowles,	230 00
Oct. 14,	pasturage,	15 00
14,	potatoes and apples,	21 50
14,	pasturage,	13 00
	Amount carried forward,	$14,306 41

DR. MASSACHUSETTS AGRICULTURAL COLLEGE *in account with* NATHAN DURFEE, *Treasurer.* CR.

CONTINGENT FUND—CONTINUED.

1867.					
Jan. 4,	*Amount brought forward,*	$0,000 00		*Amount brought forward,*	$14,306 41
4,	To cash paid J. White, (Trustee,)	50 95			
4,	J. W. Lincoln, (Trustee,)	28 35			
5,	J. W. Lincoln, bill,	5 05			
21,	H. L. Whiting, (Trustee,)	114 15			
	balance to new account,	7,354 43			
		$14,306 41			$14,306 41
			1867. Jan. 21,	By balance cash on hand,	7,354 43

GENERAL CASH ACCOUNT.

1867.			1866.		
Jan. 21,	To cash as per land scrip account,	$1,700 00	Jan. 18,	By balance cash on hand,	$22,004 36
21,	as per building fund account,	3,000 00	1867.		
21,	as per contingent fund,	6,951 98	Jan. 21,	cash as per contingent fund,	641 36
21,	balance to new account,	13,453 74	21,	as per land scrip account,	2,460 00
		$25,105 72			$25,105 72
			21,	balance cash on hand,	13,453 74

There is now outstanding a note to L. D. Cowles, on Land Account, for $11,000, with interest from November 25, 1866.

JANUARY 21, 1867. (E. E.)

Respectfully submitted,

NATHAN DURFEE, *Treasurer Mass. Agricultural College.*

Dormitory.

Laboratory.

Botanic Museum.

Durfee Plant Houses.

MASSACHUSETTS AGRICULTURAL COLLEGE.

FIFTH ANNUAL REPORT

OF THE

TRUSTEES

OF THE

Massachusetts Agricultural College.

JANUARY, 1868.

BOSTON:
WRIGHT & POTTER, STATE PRINTERS,
No. 4 Spring Lane.
1868.

ANNUAL REPORT.

To the Honorable Senate and House of Representatives.

The Trustees of the Massachusetts Agricultural College, as required by its charter, submit the following Annual Report of the condition of the institution : —

The subject of agricultural education has been in various forms before the people of the Commonwealth since 1850, when principally through the influence of Hon. Marshall P. Wilder, then president of the senate, Dr. Edward Hitchcock, president of Amherst College, was commissioned to visit the agricultural institutions of Europe, and report upon their organization and success. The first practical result of this effort, was the establishment of the Board of Agriculture, which has accomplished much, both to improve the farms and farmers of the State, and to prepare the way for the successful operation of an agricultural college.

In 1856, the Massachusetts School of Agriculture was incorporated, but, from want of funds, served only to keep the necessity of such an institution before the public. In 1860, its charter was transferred to several enterprising citizens of Springfield, who, after consultation with leading agriculturists, determined to raise by subscription $75,000 for the opening of the school in that city, relying upon the legislature for a further endowment. This project would doubtless have succeeded, had not the call to arms and the necessities of the war absorbed the public attention.

In 1862, congress, realizing more than ever the immense value of the agricultural products of the country, and the incalculable worth of improvements in farm implements, and the varieties of stock raised, and grasses, grains, root-crops and

fruits cultivated, made to each state the liberal offer of 30,000 acres of the public land for every member of congress to which it was then entitled, for the endowment of one or more colleges, the leading object of which should be to teach such branches of learning as are related to agriculture and the mechanic arts.

The legislature of Massachusetts at once accepted this generous gift of 360,000 acres of land, and, after much discussion, resolved to found one independent college for the special education of young men in scientific agriculture and horticulture. To this institution was given the proceeds of the sale of one-tenth of the land scrip for the purchase of a farm, and as an endowment two-thirds of the income of the fund obtained by the sale of the remaining nine-tenths. The other third of the income was granted to the Institute of Technology at Boston, which from its favorable location and ample endowment, possesses admirable facilities for the instruction of young men in the mechanic arts. Of the other states, which have received lands under the act of 1862, some, like Michigan, have established independent colleges for education in agriculture and the mechanic arts; others, as Connecticut, have given the income of their funds to existing institutions upon condition that instruction be furnished in the theory of agriculture and in the sciences most closely connected with it; and others, like New York, have appropriated the income of their funds to the maintenance of universities, where shall be taught the whole circle of the sciences, the liberal arts and the learned professions. The Massachusetts Agricultural College, therefore, appears to be the only one in the United States devoted exclusively to the professional education of farmers and gardeners, and with the hearty co-operation of the Board of Agriculture, may reasonably be expected to benefit greatly the agricultural interests of the Commonwealth.

Since the last Annual Report, the College and the Commonwealth have suffered an irreparable loss in the resignation and removal to a more genial climate of President P. A. Chadbourne, rendered necessary by an alarming hemorrhage from the lungs, and complete prostration of strength. During the few months of his presidency, he labored assiduously to organize the college, and contracted for the erection of three of the buildings now

completed. By his large experience and comprehensive views, his practical judgment and great energy, he was enabled, immediately upon his entrance into his difficult office, to inspire confidence, complete a satisfactory plan of organization, and harmonize conflicting views, respecting the location and style of buildings. He was elected president November 7th, 1866, and resigned June 1st, 1867.

The State and the College have also more recently been called to mourn over the sudden decease of Hon. Joseph A. Pond, member of the Board of Trustees from Middlesex County. Though elected only last winter, and consequently less familiar with the history of the College than some, he was a devoted friend of the enterprise, and an earnest worker for its welfare, especially in the legislature.

On the 7th of August last, W. S. Clark was elected president; E. S. Snell, professor of mathematics; and H. H. Goodell, professor of modern languages. It was voted to open the College for those who might wish to enter the freshman class, October 2d. By great effort the necessary buildings were completed and furniture procured, so that the first term commenced at that time. The number of students steadily increased until before the close, December 17th, forty-seven were admitted to the class. Several others were examined, but rejected on account of deficient scholarship, so that, during the first term, more than fifty applied at the College for admission. Besides these, nearly as many more, some of them from other States, have asked for information and intimated a wish to enjoy the advantages of the institution.

Buildings.

The dormitory building contains twenty-three rooms, intended to accommodate forty-six students, and no more can be received unless more than two are required to room together, which is very undesirable, for obvious reasons. It is evident, therefore, that it will be impossible to admit another class without additional buildings. It has been the design of the Board thus far to expend the fund of $75,000, pledged by the town of Amherst for such buildings as were necessary to put the College into operation, and try upon a moderate scale the experiment about which there has been so much discussion, of combining in an

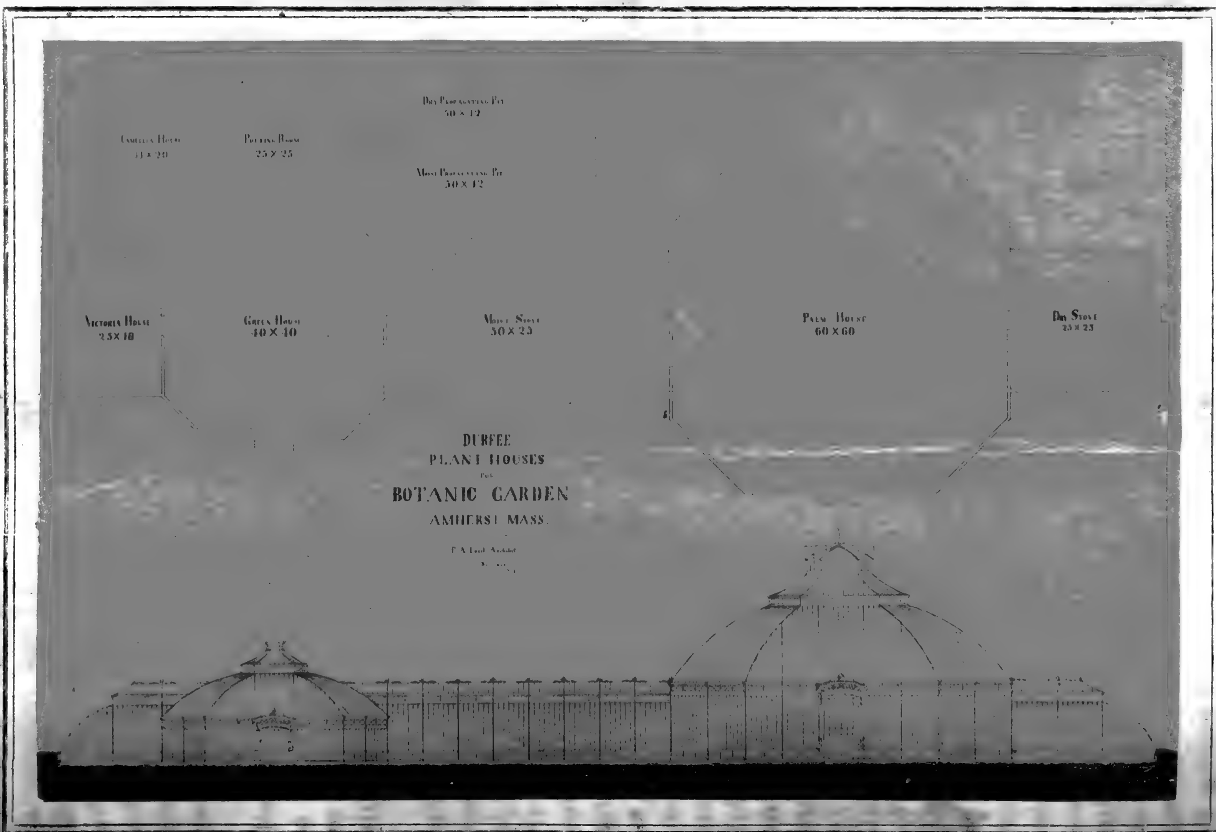
educational course, theory and practice,—scientific culture and manual labor. With this object in view they have erected a dormitory 100×50 feet and four stories high, with a basement for fuel. This edifice, besides rooms for one professor and forty-six students, contains two recitation rooms, a reading room and library, and two large rooms occupied by the State cabinet of specimens illustrating the natural history and geology of Massachusetts. This edifice, with fixtures for the public rooms, stoves, well, and the necessary grading and outbuildings, cost $36,280.

The boarding-house furnishes accommodations for a family, and has a dining-room 50×18 feet, where the students are provided with satisfactory board, at $3 per week. The cost of this building, including furniture, grading, and supplying with water, was $8,180.

The chemical laboratory is 57×46 feet and two stories high, and affords excellent rooms for lectures, practical chemistry, and apparatus. The building, including bell and grading, has cost about $10,360. It has not yet been provided with apparatus or furniture, and is used at present as a gymnasium.

The botanic museum is a two-story structure 45×31 feet, with a deep cellar for storing plants, flower-pots, sand, and other material for winter use in the glass houses adjoining. The lower floor contains the president's office and lecture room, and the upper floor will be provided with cases for the exhibition of fruit models, specimens of seeds, woods, and interesting vegetable products. The cost of this building, including furniture and grading, will be not far from $5,180.

The Durfee plant houses are an elegant group of glass buildings with curvilinear roofs, covering 5,000 square feet of surface, and heated by hot water. It is divided into five compartments, the temperature and moisture of which are entirely under the control of the superintendent. They are named the dry stove, for succulent plants; the moist stove, for true tropical species; the palm-house, for larger species of tender trees and shrubs; the camellia house, for such as require comparatively little heat, and the victoria house, for aquatic and air plants. Besides these there are two propagating pits, each 50×12 feet, one of which is supplied with a hot water tank for heating the sand beds, while in the other they are warmed by the circula-



MASSACHUSETTS AGRICULTURAL COLLEGE.

tion of water from the boilers in iron pipes. An abundant supply of soft water is procured from a reservoir on the hill north of the building, which is heated and aërated in a tank over the potting room and boilers. From the tank it is conducted in iron pipes to all parts of the house, and flows with sufficient force to feed a fountain in the victoria house, and shower all the plants as required. The plan and specifications, grading and foundations for this building cost about $2,000, and the structure itself, with heating apparatus and water, about $10,000 more, which was generously paid by Dr. Nathan Durfee, of Fall River.

A reference to the photograph accompanying this Report will furnish a correct idea of the front elevation of the entire structure, as designed by Mr. F. A. Lord, of Syracuse, N. Y., and also of the size and proposed use of the several compartments. When completed it will cover more than 10,000 square feet, and be one of the most tasteful, conveniently arranged and delightfully located buildings of the kind in the country. The value of such an establishment for experiments in hybridizing, propagating, and cultivating useful and ornamental plants, as well as in teaching horticulture and systematic botany, can hardly be overestimated. By the wise liberality of Messrs. L. M. and H. F. Hills, of Amherst, the College has been provided with a fund of $10,000, the income of which is to be expended in the purchase of such seeds, plants and books as may be needed in this department.

Plans and specifications for a model barn have been procured, and the sum of $7,000 appropriated for its construction. The stone and much of the lumber will be taken from the lands of the College and hauled to the location selected, on the central ridge of the farm, about forty rods south of the dormitory, the present winter. The barn is intended to stand on the western slope of the ridge and to be 100×50 feet, with posts 28 feet high. The upper, or threshing floor, is to be ten feet above the sills and entered by a bridge from a wall fourteen feet east of the building. The lower story contains stables, root-room, granary, and feeding floor, with bay for hay, which is to be thrown down from the upper floor. In the second story is the tool-room and corn-house, and underneath the whole of the main building a cellar for manure. The barn stands east and

west, with an ell on the west end, extending south from the building 100 feet, for a shelter to the stock and for storage. On the east end of the barn is another ell, 30×20 feet and two stories in height, with horse stable and carriage room above and piggery below. The entire structure will hold about 175 tons of hay. Another barn of equal capacity will ultimately be necessary upon the north side of the farm, near the extensive pile of old buildings purchased of L. D. Cowles, and now occupied by the College.

Near the east side of the farm is a beautiful eminence, crowned with a grove of large chestnuts and oaks, and rising nearly three hundred feet above the river, which bounds the College property on the west. From a prospect tower among the trees on the summit might be seen every part of the farm and also a magnificent view of the Connecticut flowing through the best agricultural district of the Commonwealth, from Sugar Loaf Mountain on the north to Mounts Holyoke and Tom on the south. At the suggestion of friends residing in the vicinity, a plan has been procured for a tower seventy feet in height, and there is reason to expect from them funds for its erection the ensuing season.

The sum of $6,000 has been taken from the building fund to pay for the farm houses and barns upon the farm, and applied to the purchase of additional land, so that the College now owns 383½ acres. It was deemed best to purchase this amount of land, although a portion of it should remain for a time unpaid for, as it would never be worth less than the price agreed upon, and hereafter it might be impossible to procure it at a reasonable rate. The cost of the farm exceeded the sum received from the sale of the land scrip, devoted to this object by law, $7,221.60.

From the foregoing statement, it appears that the sum of $75,000 has been expended or appropriated for buildings and furniture, besides the $10,000 given by Dr. Durfee.

With its present buildings the College will be able to educate about fifty young men, and unless others are provided the present class must be retained four years, and when they graduate another class of fifty can be admitted for the full course. If, however, another dormitory building, with public rooms on the first floor, another boarding-house and two houses for professors

were erected next summer, another class of sixty could be accommodated. This would require an expenditure of $50,000. The entire sum now invested in the Agricultural College is $275,000, and the number of students which might be profitably educated there at one time is three hundred. The State has thus far only appropriated to the institution $20,000, or about enough to pay the cost of salaries, surveys, plans and traveling expenses during the five years of preliminary operations. It remains, therefore, for your honorable body to decide whether the public interest requires an appropriation of $50,000 for the erection of the buildings necessary to enable the College to go on with its regular course and receive next year another class, or whether the present class shall enjoy all the benefit of the College farm and funds during the next four years.

Farm Operations.

Most of the College property was rented until April 1, 1867, and up to that date little preparation had been made for farm work. About that time Levi Stockbridge was elected farm superintendent, and entered with energy upon the duties of his office. Teams and tools were purchased, and about sixty acres plowed and planted with corn, potatoes, or root crops, or sown with oats. Ten acres were thoroughly underdrained, and many rail fences, hedge-rows, and stones removed from the fields. During the autumn the students have dug up about fifty old apple-trees and cut out at the roots the brush from eight acres of the pasture lands near the river. They have also harvested nearly all the fall crops, and threshed out the oats. More than 200 tons of excellent hay was cut, and the larger part housed in good condition.

In consequence of the great amount of work required in the construction of roads and walks, and in grading about the new buildings, it has been impossible for the superintendent to enter upon any extensive plan for the improvement and general management of the farm. This will be done however as rapidly as may be practicable, so as to render the estate a model, worthy the attention of the farmers of the Commonwealth.

It is also the intention of the Trustees to enter upon a course of experiments such as may be suggested by the Board of Agriculture, or by any who may be familiar with the difficulties of

practical farming and gardening. These experiments, performed under the direction of scientific men, cannot fail to be of great value in testing implements, fertilizers, and the different modes of raising, improving and utilizing the various products of the soil.

The College should be a perpetual agricultural fair, where the finest specimens of the best breeds of live stock of all kinds may be seen and compared. To procure such animals will demand a considerable expenditure of money and several years' time. It is confidently hoped that wealthy breeders will be willing to contribute occasionally specimens of the flocks and herds which afford them so much satisfaction, and so greatly advance the agricultural interests of the State.

The animals now owned by the College are as follows, viz.: 20 very fine Southdown ewes, 2 Southdown bucks and 1 Cotswold buck, 1 Ayrshire and 1 Alderney bull calf, 3 pairs of oxen, 18 three-years old steers, and 15 yearlings, all grade Shorthorns; 3 milch cows, 3 horses, and 3 Suffolk swine.

The superintendents of the farm and garden will keep an accurate account of all receipts and expenditures in their respective departments, and will adopt the most approved system of book-keeping as applied to the business of the farmer. This will not only be of service in the management of the affairs of the College, but will aid in the introduction of this most important practice among the agriculturists of the State.

Botanic Garden and Horticultural Department.

During the past season the grounds have been drained and graded, and plans for the principal roads and walks determined upon, and a portion of them constructed. The museum and plant-houses have been completed, and about 400 species and varieties of rare and interesting plants are now growing under the glass. Among the most valuable of these may be mentioned the choice collection of camellias, presented by Hon. Marshall P. Wilder; a large century plant, with variegated foliage, planted in the open ground of the dry stove, and surrounded by a fine collection of succulent plants, consisting of many large cactuses, euphorbias, aloes, crassulas, and mesembryanthemums, presented by W. S. Clark; large specimens of latania, pandanus, banana, ficus, hibiscus, crinum, ananassa, passiflora,

dracæna, and many other genera; numerous species of maranta, begonia, alocasia, caladium and other plants with beautiful leaves; several of the choicest orchids, and numerous ferns and lycopods. This garden will form one of the most attractive as well as instructive features of the College, and has already awakened much interest among the horticulturists of the Commonwealth. If those who have interesting plants will be kind enough to supply the garden, either by way of donation or exchange, it will be of great service to the institution in its efforts to educate in the most thorough manner its students in the delightful occupation of Eden, and to increase among the people the love of the beautiful, and the cultivation of flowers and fruits.

Course of Study and Instruction.

The general plan of organization adopted by the Board and approved by the governor and council, has been made the basis of the course laid down in this Report. It has been the intention to arrange the recitations and lectures so as to allow half of every day for manual labor, or for study, as might be desirable, and whenever instruction is given to four classes, two of them will recite in the forenoon and the others in the afternoon. It will then be practicable to have all the work of the farm and garden performed by students, as it ought to be. During the fall term all were required to labor, without pay, two hours every other day, and those who wished it were paid for additional work at the rate of twelve and one-half cents per hour. In special cases, where the amount and kind of labor would warrant it, a somewhat higher rate was paid. Thirty-six of the class voluntarily worked for wages, some earning but little, while others received considerable sums. One was paid $30.38, two others $29.75 each, another $29, another $21.71, and another $16.58. It is perhaps worthy of note that the best scholar in the class has also earned the most money. All the students cheerfully complied with the regulations for study and labor, so that no case for severe discipline occurred during the term. Any misconduct or failure in the field, or recitation room, is noted by a certain number of demerit marks, and every duty faithfully and successfully done is marked on the scale of one hundred for perfection. At the

end of the term the average is taken and reduced for absences and demerit marks. If the average rank thus obtained is above fifty, the student is allowed to remain a member of the class, but if less, his parent or guardian is informed that he cannot return. At the end of each term a report concerning every student, giving his rank in all departments, his absences, demerits, and wages earned is sent to his parent or guardian.

The full course of study occupies four years, and those who complete it will receive the degree of Bachelor of Science. Three recitations, or their equivalent in lectures or literary exercises, are assigned for each day, except Saturday and Sunday. Saturday afternoon is devoted to scientific excursions and recreation. On Sunday all are required to attend church, or Bible class; but in all biblical instruction the inculcation of denominational views is, as far as practicable, to be avoided.

At the close of each term, thorough examinations are held upon the studies gone over. All the manual labor is directed either by the farm superintendent, or the director of the garden, but it is not deemed important that an officer of the faculty should always be present in the field, except as necessary for purposes of instruction. Each squad of six or eight is under command of one of their own number, who superintends their labor, and reports misconduct to the officer in charge.

The present members of the College average more than seventeen years old, and with young men of that age, who appreciate their advantages, there appears to be no difficulty in reference to the labor question. They understand that the object is simply to render them expert in their profession, and that practice is as necessary in the various operations of the farm and garden, as in the dissecting-room of the surgeon, or the laboratory of the chemist.

An effort has been made so to arrange the studies of the regular course, as to enable the smallest possible number of officers to impart the necessary instruction. This will allow the Board to pay liberal salaries to first-rate men, who will then cheerfully devote their entire energies to the important duties of their respective chairs. The faculty will be enlarged as rapidly as the increase in the number of students demands, and the education given will be as thorough and practical as possible.

The expense of living at the College will be reduced to the lowest point compatible with health and comfort, since, while the advantages of the institution are freely offered to all, they are specially designed to benefit the industrial classes. A young man of good talents, healthy, and willing to work, can here procure a superior education for $100 per annum, in addition to what he can earn on the premises.

Military Science.

In accordance with the act of congress, granting lands for the establishment of the College, the legislature of 1863, in the Act of incorporation, made it incumbent upon the Trustees to provide instruction in military tactics. During the past year the national government has had under consideration the subject of founding professorships of military science in one or more colleges in every State. After visiting the leading colleges of the country, Major J. H. Whittlesey, to whom the matter was referred by the secretary of war, has prepared a bill upon the subject, which, with his report, has been laid before congress. If the bill becomes a law, it will be necessary for the legislature to designate the College in the Commonwealth, which shall enjoy the benefit of the act; and as the Agricultural College is obliged to teach military tactics, and is a State institution, it seems eminently proper that it should be selected as the military college of Massachusetts.

Meanwhile, until other provision is made, the Board would respectfully ask that His Excellency the Governor be authorized to issue to the president of the College such military arms and equipments as may, in his judgment, be so issued, without detriment to the militia service.

Conclusion.

Appended to this Report will be found a financial statement of the permanent funds, real and personal property, liabilities, and assets of the College, with the report of the Treasurer. In the report of last year, the building fund was credited with interest, amounting to $5,085, which was reckoned as due on the $75,000 pledged by Amherst. As, however, the law only demanded $75,000 for the erection of buildings when needed,

and as there was unforeseen delay in organizing the College, it has been deemed proper to make no demand for interest. The sum of $60,156 has been paid, and the balance, $14,843.33, is amply secured, and will be paid upon the demand of the treasurer, which has not been made, because the money was not needed.

The sum of $10,000, given by Nathan Durfee, and placed in the statement of last year among the funds for the maintenance of the Botanic Garden, has been paid and expended for the erection of plant-houses, according to the intent of the donor.

The catalogue of officers and students contains the names of the present Board of Trustees, and of those students who have been admitted to the freshman class since the opening of the institution, in October last.

Following this will be found the terms of admission, the calendar, and the necessary expenses of the student.

The list of donations for the year shows that many persons are interested in the success of the College, and this kindly feeling is often as valuable as the gift, and greatly encourages those who are actively engaged in the daily duties of this important and novel enterprise.

The act of congress, granting land for the endowment of the College, requires that "An annual report shall be made regarding the progress of each college, recording any improvements and experiments made, with their cost and results, and such other matters, including state industrial and economical statistics, as may be supposed useful, one copy of which shall be transmitted by mail free, by each, to all the other colleges which may be endowed under the provisions of this act, and also one copy to the secretary of the interior."

In accordance with this requirement is added a register of meteorological observations, giving the complete statistics of the weather at Amherst, for the year 1867, and a most valuable summary of similar observations for the past thirty years. Nothing affects the operations of husbandry more than the ever-varying elements which make up the climate of any locality; and experiments for the solution of agricultural problems can be made truly valuable only by a careful consideration of the amount of sunshine, heat and moisture during the entire period of trial.

Finally, encouraged by the successful opening and prosperous condition of the institution under their charge, the Trustees confidently hope that the College which Massachusetts has honored with her name, and pledged herself to maintain forever, and which is peculiarly the people's College, will receive from your honorable body the means necessary to carry out, in a creditable manner, the plan adopted for its organization.

Respectfully submitted,
By order of the Trustees,

W. S. CLARK, *President.*

AMHERST, Jan. 1st, 1868.

CATALOGUE

OF

TRUSTEES, OVERSEERS, FACULTY AND STUDENTS.

Board of Trustees.

MEMBERS EX OFFICIIS:

HIS EXCELLENCY ALEXANDER H. BULLOCK.
HON. JOSEPH WHITE, *Secretary of Board of Education.*
HON. CHARLES L. FLINT, *Secretary of Board of Agriculture.*
WILLIAM S. CLARK, *President of the College.*

ELECTED BY THE LEGISLATURE:

MARSHALL P. WILDER, . . .	of NORFOLK COUNTY.
CHARLES G. DAVIS, ...	PLYMOUTH COUNTY.
NATHAN DURFEE, ...	BRISTOL COUNTY.
HENRY COLT, ...	BERKSHIRE COUNTY.
CHARLES C. SEWALL, ...	NORFOLK COUNTY.
PAOLI LATHROP, ...	HAMPSHIRE COUNTY.
PHINEAS STEDMAN, ...	HAMPDEN COUNTY.
ALLEN W. DODGE, ...	ESSEX COUNTY.
GEORGE MARSTON, ...	BARNSTABLE COUNTY.
WILLIAM B. WASHBURN, . . .	FRANKLIN COUNTY.
GEORGE L. WHITING, ...	DUKES COUNTY.
D. WALDO LINCOLN, ...	WORCESTER COUNTY.
HENRY F. HILLS, ...	HAMPSHIRE COUNTY.
——— ———, ...	MIDDLESEX COUNTY.

Board of Overseers.

THE STATE BOARD OF AGRICULTURE.

Members of Faculty.

WILLIAM S. CLARK, Ph. D.,
President and Professor of Botany and Horticulture, and Director of the Botanic Garden.

LEVI STOCKBRIDGE,
Farm Superintendent and Instructor in Agriculture.

EBENEZER S. SNELL, LL. D.,
Professor of Mathematics.

HENRY H. GOODELL, A.M.,
Professor of Modern Languages, and Instructor in Gymnastics and Military Tactics.

Freshman Class.

Allen, Gideon H.,	Marion.
Barrows, William, Jr.,	Amherst.
Bassett, Andrew L.,	Amherst.
Bell, George H.,	Amherst.
Birnie, William P.,	Springfield.
Blunt, Charles E.,	Nashua, N. H.
Bowker, William H.,	Phillipston.
Breck, Webster,	Watertown.
Brett, William F.,	North Bridgewater.
Brown, Clarence E.,	Florence.
Cary, William H.,	Amherst.
Casey, Michael F.,	Amherst.
Caswell, Lilley B.,	Fitchburg.
Cole, Daniel P.,	Springfield.
Cowles, Homer L.,	Hadley.
Crocker, Loring, Jr.,	Barnstable.
Eastman, George H.,	Amherst.
Ellsworth, Emory A.,	Barre.
Fisher, Jabez F.,	Fitchburg.
Fuller, George E.,	Amherst.
Graves, George G.,	Amherst.
Greene, William H.,	Hadley.
Gunn, Charles B.,	Montague.
Hall, Frederick A.,	Amherst.
Hall, Lemuel W.,	Amherst.
Hawley, Frank W.,	Hadley.
Herrick, Frederick St. C.,	Lawrence.
Howland, Charles M.,	Amherst.
Hubbard, Frank,	Amherst.
Kelleher, David W.,	Cambridge.
King, Albert,	Taunton.
Leonard, George,	New Bedford.
Luther, Gardiner C.,	Providence, R. I.
Lyman, Robert W.,	Easthampton.
Morse, James H.,	Salem.
Nash, Edwin D.,	Northfield.
Nichols, Lewis A.,	Danvers.
Norcross, Arthur D.,	Monson.
Page, Joel B.,	Conway.
Rankin, Austin A.,	Pelham.
Richmond, Samuel H.,	Taunton.
Russell, William D.,	Sunderland.

Slattery, William, Jr.,	Amherst.
Smead, Edwin,	Greenfield.
Southwick, Alonzo L.,	Blackstone.
Sparrow, Lewis A.,	Medway.
Strickland, George P.,	Amesbury.
Swift, George A.,	Charlestown.
Thompson, Edgar E.,	Hopkinton.
Tucker, Wilson M.,	Monson.
Ware, Willard C.,	Salem.
Wheeler, Charles A.,	Hopkinton.
Wheeler, William,	Concord.
Whitney, Frank L. P.,	Boston.
Williams, Henry,	Williamstown.
Woolson, George C.,	Hopkinton.
Total,	56.

COURSE OF STUDY AND INSTRUCTION.

Freshman Year.

First Term.—Algebra; Human Anatomy and Physiology; Chemical Physics.

Second Term.—Geometry; French; Chemistry.

Third Term.—Geometry; French; Botany.

Lectures upon Hygiene, Chemistry, Botany and Agriculture; and Exercises in Orthography, Elocution, and English Composition, during the year.

Sophomore Year.

First Term.—German; Agriculture; Commercial Arithmetic and Bookkeeping.

Second Term.—German; Trigonometry; Analytical Chemistry.

Third Term.—Mensuration; Surveying; Analytical Chemistry; Zoölogy; Drawing.

Lectures upon Comparative Anatomy, Diseases of Domestic Animals, Organic Chemistry and Market Gardening; and Exercises in English Composition and Declamation, during the year.

Junior Year.

First Term.—Physics; French or German; Agricultural Chemistry; Drawing.

Second Term.—Physics; Rhetoric; Horticulture.

Third Term.—Astronomy; Systematic Botany; History of the United States.

Lectures upon Physics, Mineralogy, The Cultivation of the Vine, and Fruit and Forest Trees, and Useful and Injurious Insects; and Exercises in English Composition and Debate, during the year.

Senior Year.

First Term.—Intellectual Philosophy; History; Physical Geography.

Second Term.—Moral Philosophy; Political Geography; The Civil Polity of Massachusetts and the United States.

Third Term.—Geology; Engineering; Political Economy.

Lectures upon Stock Farming, Architecture, Landscape Gardening, Geology and English Literature; and Exercises in Original Declamation and Debate, during the year.

Exercises in Gymnastics, Military Tactics, and the various operations of the Farm and Garden, through the course.

Admission.

Candidates for admission are examined in writing upon the following subjects: English Grammar, Geography, Arithmetic, and Algebra, to Quadratic Equations.

Candidates for higher standing are examined as above, and also in the studies gone over by the class to which they may desire admission.

No one can be admitted to the College until he is fifteen years of age; and every student is required to furnish a certificate of good character from his last pastor or teacher, and to give a satisfactory bond for the prompt payment of term bills. Tuition and room-rent must be paid in advance, at the beginning of each term; and bills for board, fuel and washing at the end of every term.

The regular examination for admission is held at the Botanic Museum, at 9 o'clock, A. M., on the second Thursday of September; but candidates may be examined and admitted at any other time in the year.

Further information may be obtained from President W. S. Clark, Amherst, Mass.

Calendar.

The academic year is divided into three terms:

The first term begins the second Thursday of September, and continues thirteen weeks.

The second term begins the fourth Thursday of January, and continues thirteen weeks.

The third term begins the first Thursday of May, and continues thirteen weeks.

Expenses.

Tuition, . .	per term, $12 00; . .	per annum,	$36 00
Room Rent, . .	" 5 00; . .	"	15 00
Board, . . .	per week, 3 00; . .	"	117 00
Fuel, Washing, &c., at cost—about,	. . .	"	25 00
Incidental Expenses about $1 00 per term,	. .	"	3 00
			$196 00

DONATIONS.

The following donations have been made to the College the past year:

From Dr. George B. Loring, Salem, 1 Alderney and 1 Ayrshire bull calf.

From Dr. Nathan Durfee, Fall River, 1 Cotswold and 1 Southdown buck, and a valuable collection of gloxinias and other hot-house plants.

From Thomas Buffum, Esq., Newport, R. I., 1 Southdown buck.

From M. Smith, Esq., Worcester, 1 horse rake.

From Clipper Mowing Machine Co., Yonkers, N. Y., 1 Clipper Mowing Machine.

From Walter Woods, Esq., Hoosic Falls, N. Y., 1 Woods' Mowing Machine.

From J. T. Ames, Esq., Chicopee, 50 species and varieties of plants, including caladiums, begonias, marantas, and others, with ornamental foliage.

From Olm Brothers, Springfield, 20 species of rare hot-house plants.

From Prof. Asa Gray, Botanic Garden, Cambridge, 20 species greenhouse plants, and seeds of 21 species of Australian trees and shrubs.

From W. S. Clark, Amherst, 200 species succulent and stove plants.

From Hon. Marshall P. Wilder, Dorchester, 1,300 specimens, including 100 camellias, of the choicest varieties, many very large; a large bouquet orange; 100 herbaceous and 25 tree peonias; 100 roses; 100 Japan lilies; 100 gladioli; 100 greenhouse and stove plants; 100 hardy flowering shrubs, and many fine varieties of currants and raspberries.

From Miss Sarah Ferry, Amherst, 1 large hoya carnosa.

From Austin Eastman, Esq. Amherst, 1 large oleander and 1 large lemon.

From Mrs. H. F. Hills, Amherst, 1 araucaria imbricata.

From Hon. William B. Washburn, Greenfield, 100 volumes Congressional Documents.

From Allen W. Dodge, Esq., Hamilton, 57 volumes of books on Agriculture and Horticulture.

From Hon. C. L. Flint, 54 volumes Transactions of Agricultural Societies and State Boards of Agriculture.

From H. F. Hills, Esq., Amherst, 1 volume, French on Drainage.

From G. & C. Merriam, Springfield, 1 copy Webster's Unabridged Dictionary, 1868.

From Hon. H. K. Oliver, Salem, 34 volumes, including 20 volumes on Bee Culture.

From Mrs. Richard S. Fay, Salem, 11 volumes on Agriculture.

From John W. Proctor, Esq., Danvers, 36 volumes on Agriculture.

From the Publishers,—"The Boston Cultivator" for 1868; "The American Agriculturist," 1868; "The Massachusetts Ploughman," 1868; "The New England Homestead," 1868; "The Hampshire Express," 1868; "The American Naturalist," 1867–8; "The American Journal of Horticulture," 1867–8; "The Proceedings of the Essex Institute," 1867–8.

From Hon. Alvah Crocker, Fitchburg, 1 volume, Fitchburg in the Rebellion.

From John A. Whipple, Esq., Boston, 1 portrait in oil of Hon. Marshall P. Wilder.

From J. W. Boynton, Esq., Hartford, Conn., 1 green rose.

From J. L. Beal, Esq., Union Springs, N. Y., 1 rose.

FINANCIAL STATEMENT FOR JANUARY 1ST, 1868.

Real Estate.

The College farm contains 383½ acres, and cost, exclusive of buildings,	$37,000 00	
The quarry in Pelham, cost	500 00	
		$37,500 00

Buildings.

North College, of brick, 100 × 50 feet, four stories, with cases for books and cabinet specimens, desks and chairs for public rooms, stoves, well, out-buildings and architect's bill, cost	$36,280 00	
Chemical Laboratory, of wood, 57 × 46 feet, two stories, with bell, cost	10,360 00	
Boarding-House, of wood, with dining hall 50 × 18 feet, with furniture, cost	8,180 00	
Botanic Museum, of wood, 45 × 31 feet, two stories, with office and lecture room of president, with cases and furniture, cost	5,180 00	
Durfee Plant-Houses, with water, heating apparatus and shelving, cost	12,000 00	
Three dwelling-houses and four barns, bought with the farm, cost	6,000 00	
		78,000 00
Total real estate,		$115,500 00

PERSONAL PROPERTY IN CHARGE OF FARM SUPERINTENDENT.

Live Stock.

45 neat cattle, valued at	$3,290 00	
23 sheep, "	445 00	
3 horses, "	750 00	
3 swine, "	25 00	
		$4,510 00

Farm Produce.

150 tons hay,	$1,800 00	
20 tons oat straw,	120 00	
20 tons corn stover,	120 00	
600 bushels oats,	450 00	
700 bushels corn,	700 00	
100 bushels potatoes,	75 00	
250 bushels roots,	82 50	
		$3,347 50

Farm Implements.

Wagons, carts and harnesses,	$755 00	
Tools of various kinds,	730 00	
		$1,485 00
Total personal property,		$9,342 50

FUND FOR MAINTENANCE OF COLLEGE IN CHARGE OF THE STATE TREASURER.

The total amount received from the sale of the 360,000 acres of land given to Massachusetts, for the endowment of one or more colleges for the promotion of education in agriculture and the mechanic arts, is	$236,307 40
Of this amount, in accordance with the Act of Congress, was expended for a farm,	29,778 40

The investments of the fund made by the State Treasurer are as follows:—

United States bonds, 5-20's, interest 6 per cent. gold,	$50,500 00
" " " 10-40's, " 5 " "	30,000 00
Massachusetts bonds, 5 per cent. gold,	24,000 00
" " 6 per cent. currency,	3,000 00
City of Salem bonds, 6 " "	55,000 00
City of Lynn bonds, 6 " "	25,000 00
Town of Milford bonds, 6 " "	14,200 00
Par value of bonds,	$201,700 00
Cash uninvested,	5,724 65
Total fund,	$207,424 65
Annual income of fund at 6 per cent.,	$12,445 48

Two-thirds of this is to be paid to the treasurer of the College, and one-third to the treasurer of the Institute of Technology.

Income of College from fund,	$8,296 99
By the conditions of the gift none of the income of the fund derived from the sale of land scrip can be used for the erection or repair of buildings.	
The Hills Fund of $10,000 for the maintenance of the Botanic Garden is in charge of the College treasurer, and at present yields an income of	500 00
Total income from funds,	$8,796 99

To this sum should be added the receipts of tuition and room rent, amounting to $51 per annum for each scholar, and the receipts from the sale of the products of the farm and garden.

Liabilities of the College, January 1st, 1868,	$29,727 61
Available funds, " " "	25,446 87

TREASURER'S REPORT.

4

Dr. **Massachusetts Agricultural College**, *in account with* **Nathan Durfee**, *Treasurer*. Cr.

LAND ACCOUNT.

1867. July 23,	To cash paid for balance of "Cowles' Farm,"	$8,000 00		1867. Jan'y 21,	By balance, old account.	$5,889 31
Dec. 8,	L. D. Cowles, interest on note,	660 00			build'gs on farm purchased, charged to building Fund,	6,000 00
31,	balance to new account,	3,229 31	$11,889 31			$11,889 31
				1868. Jan'y 1,	By balance, old account,	$3,229 31

BUILDING FUND.

1867.	To cash paid for farm buildings,	$6,000 00	1867. Jan'y 1,	By balance of old account,	$210 00
	to architect and contractors,	47,930 19		cash from town of Amherst,	50,000 00
	Church and White, carpenters,	932 26		from S. Williston,	4,946 67
	Thomas and Ingraham, painters,	145 00		from N. Durfee,	10,000 00
	Graves Brothers, painters,	305 00			$65,156 67
	B. F. Trowbridge, painter,	275 00			
	R. H. Kellogg, lightning rods,	158 16			
	Moody and Cooke, masons,	635 50			
	N. W. Purple, slate,	150 00			
	R. H. Howard, brick,	844 60			
	Jenkins and Braley, stone,	111 87			
	labor in excavating, grading and teaming,	2,885 34			
	sundries, as per bills on file,	321 37			
		$60,694 29			
1868. Jan'y 1,	To balance to new account,	4,462 38	1868. Jan'y 1,	By balance from old account,	$4,462 38
		$65,156 67			

CONTINGENT FUND.

1867.	To paid expenses of trustees,	$664 23	1867. Jan'y 1,	By balance of old account,	$7,354 43
	J. H. Shedd, engineer,	443 12		cash from State Treasurer, income of fund,	10,930 00
	salaries,	3,250 00		cash from term bills,	1,375 16
	land damages in changing highway,	637 50		from farm produce,	1,346 77
	books and stationery,	167 68			$21,006 36
	printing and advertising,	148 31			
	postage and revenue stamps and telegrams,	28 61			
	freight and express charges,	360 04			
	fuel,	733 60			
	bells,	126 25			
	furniture for boarding-house and public rooms,	1,513 82			
	insurance,	678 50			
	Mrs. T. D. Smith, for boarding students,	1,016 54			
	Mrs. Stack, for washing,	47 43			
	farm implements,	837 96			
	live stock,	4,210 83			
	fertilizers and grass seeds,	748 75			
	drain tile and tarred paper,	368 10			
	labor on roads,	1,022 64			
	permanent farm improvements,	1,050 87			
	ordinary farm expenses,	2,409 07			
	sundries as per bills on file,	485 12			
1868. Jan'y 1,	balance to new account,	57 39	1868. Jan'y 1,	By balance, old account,	$57 39
		$21,006 36			

DR. MASSACHUSETTS AGRICULTURAL COLLEGE, *in account with* NATHAN DURFEE, *Treasurer.* CR.

GENERAL ACCOUNT.

1867.	To cash paid on Land Account,	$8,660 00	1867. Jan'y 1,	By balance cash on hand,	$13,453 74
	on Contingent Fund,	20,948 97		cash received on account Contingent Fund,	19,651 93
	on Building Fund,	60,694 29		cash received on account Building Fund,	64,946 67
1868. Jan'y 1,	To balance to new account,	7,749 08			
		$98,052 34			$98,052 34
			1868. Jan'y 1,	By balance being cash on hand,	$7,749 08

Respectfully submitted,

NATHAN DURFEE, *Treasurer*
Massachusetts Agricultural College.

I have examined the Treasurer's accounts and find them correctly stated and accompanied with the proper vouchers.

D. WALDO LINCOLN, *Auditor.*

BOSTON, February 6, 1868.

REGISTER OF METEOROLOGICAL OBSERVATIONS

For the year 1867:

TAKEN AT AMHERST, MASS.,

BY E. S. SNELL,

Professor of Mathematics in the Massachusetts Agricultural College.

Latitude, 42° 22′ 17″. Longitude, 72° 34′ 30″. Height above the sea, 267 ft.

REMARKS.

A meteorological journal has been kept at Amherst a little more than thirty years, a record being made three times every day, of the temperature, the pressure of air, the direction and force of wind, the quantity, kind, velocity and direction of the clouds, the amount of moisture in the air, and the depth of rain and snow. Since the Smithsonian Institution began its operations, these observations have been made at the hours which it has adopted, namely, 7 A. M., 2 P. M., and 9 P. M.

The mean annual temperature at Amherst for the last thirty years is 46.15 degrees, ranging from the highest, 48.02 degrees in 1846, to the lowest, 44.66 degrees in 1861. The greatest difference therefore in the annual mean for thirty years, is 3.36 degrees. The mean temperature of 1867 was 46.17 degrees, 0.02 of a degree above the mean for thirty years. The highest temperature observed during the year was 90 degrees, July 4; the lowest was 5 degrees below zero, January 16.

The mean atmospheric pressure, measured by the barometer, depends on the altitude of the station above the sea-level. The barometer used for the Amherst observations is 267 feet above the ocean. The mean height of the mercury column, during the last thirty years, was 29.723 inches, ranging from 29.780, the greatest annual mean, in 1849, to 29.643, the least, in 1837. In 1867, the mean height of the barometer was 29.731 inches; the greatest height was 30.584, Feb. 11, and the least, 28.991, May 9. Since mercury is lighter when warmer, and heavier when colder, the results given in the accompanying table have all been reduced from the observed numbers to the standard temperature of 32 degrees.

The depth of rain and snow in a year is quite variable in this climate. During the last thirty years, the mean annual depth of water, (rain and melted snow,) has been 44.21 inches. The greatest fall was 56.183 inches in 1863; and the least, 34.433 inches in 1864, a year of unusual drought. In 1867, the fall of water was 46.087 inches, nearly 2 inches above the mean. August was a very rainy month, in which there fell more than 9 inches; while in each of the months, January and September, there was only a fraction more than 1 inch.

The depth of snow was 3.666 feet in 1867. In a series of years, the annual depth in this place has varied from 2.500 feet to 6.750 feet.

The record of winds includes two particulars, — the quarter from which they flow, and their estimated force. The latter ranges from one, the least perceptible motion, to ten, a destructive tornado. Regarding both time and force, nearly one-half of the wind in this locality is from the N. W. quarter; one-fourth from the S. E.; one-eighth from the S. W.; one-eighth from the N. E.; though these proportions are not very uniform. The year 1867 differs considerably from the mean, there being less wind than usual from the N. W., and more than usual from the N. E. The results are as follows: N. W., 43 per cent; S. W., 16; S. E., 24; N. E., 17. The large amount from the N. E. was mainly due to the winds of March, 35 per cent. of which were from that quarter.

The cloudiness is obtained by noticing how many tenths of the sky are covered at the time of each observation, The mean cloudiness for a series of years at this station differs but very little from 50 per cent. The mean for 1867 is higher than usual, amounting to 54 per cent. The kinds of cloud are marked by abbreviations, thus, *Str.* stratus, that is, spread in sheets; *Cum.* cumulus, piled in heaps; *Cir.* cirrus, drawn out in fibres. Intermediate kinds are, *Cu-str.* cumulo-stratus; *Cir-str.* cirro-stratus; *Cir-cum.* cirro-cumulus.

The moisture in the air is expressed by two numbers, one of which denotes the actual pressure of moisture by the height of mercury sustained by it; this number is called the "force of vapor." The other number, called "humidity," expresses what per cent. of the greatest possible moisture actually exists at a given time. The greatest humidity is therefore 100. But when the humidity is 100, the quantity of moisture, (that is, the force of vapor,) depends on the temperature, being greater as the temperature is higher. Therefore, if the humidity is 100, and the temperature falls, a part of the moisture must cease to exist in the form of vapor, and must be precipitated in dew, fog, rain or some other liquid or solid form.

The mean force of vapor at this place is about 0.30 of an inch of mercury, and the mean humidity about 78 per cent. The force of vapor in 1867 was 0.31 of an inch, and the humidity 84 per cent. The great humidity of January and August contributed especially to raise the mean result.

JANUARY, 1867.

Day of Month.	Thermometer in the open air. 7 A. M.	2 P. M.	9 P. M.	Mean.	Rain and snow. Time of begin'g of rain or snow.	Time of ending of rain or snow.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Clouds. 7 A. M. Amount of cloudiness.	Kind of clouds.	2 P. M. Amount of cloudiness.	Kind of clouds.	9 P. M. Amount of cloudiness.	Kind of clouds.
1	21.7	31.0	28.0	26.9	10 A. M.	Night.	0.053	1.0	10	Str.	10	Nim.	10	Nim.
2	16.5	24.8	20.5	20.6	-	-	-	-	7	Str.	8	Str.	7	Str.
3	2.5	15.2	9.4	9.0	-	-	-	-	5	Str.	-	-	-	-
4	1.0	17.9	17.7	12.2	-	-	-	-	1	Str.	-	-	-	-
5	16.7	29.0	33.4	26.4	*	-	0.020	0.5	9	Str.	2	Str.	10	Str.
6	29.7	31.8	27.3	29.6	-	-	-	-	10	Str.	10	Nim.	5	Str.
7	19.0	25.0	18.0	20.7	-	-	-	-	3	Str.	4	Str.	-	-
8	13.5	23.0	14.0	16.8	-	-	-	-	2	Str.	-	-	-	-
9	14.0	27.0	25.7	22.2	-	-	-	-	1	Str.	2	Str.	4	Str.
10	12.8	30.0	22.9	21.9	-	-	-	-	8	Str.	5	Str.	10	Str.
11	12.7	27.2	19.7	19.9	-	-	-	-	8	Str.	8	Str.	4	Str.
12	14.7	20.0	12.0	15.6	-	-	-	-	-	-	-	-	-	-
13	8.7	26.5	14.7	16.6	†	-	-	-	9	Str.	8	Str.	10	Str.
14	14.0	21.9	13.0	16.3	-	-	-	-	2	Str.	-	-	-	-
15	7.0	17.0	9.7	11.2	-	-	-	-	5	Str.	3	Cir. & Str.	2	Str.
16	-5.0	13.9	9.0	6.0	Night.	-	-	-	-	-	5	Str.	7	Str.
17	11.5	17.4	17.8	15.6	-	Night.	0.305	5.0	10	Nim.	10	Nim.	10	Nim.
18	10.5	9.0	2.0	7.2	-	-	-	-	10	Str.	9	Str.	-	-
19	0.0	10.9	10.0	7.0	-	-	-	-	1	Str.	8	Str.	7	Str.
20	5.6	18.7	18.0	13.9	Night.	-	-	-	5	Str.	5	Str.	10	Str.
21	21.9	24.0	24.7	23.5	-	3 P. M.	0.528	5.0	10	Nim.	10	Nim.	10	Nim.
22	18.5	29.4	25.7	24.5	-	Night.	0.030	0.5	4	Str.	2	Str.	7	Str.
23	23.0	30.2	27.3	26.8	-	-	-	-	7	Str.	2	Str.	2	Str.
24	29.0	33.5	19.2	27.2	-	-	-	-	9	Str.	2	Cir.	-	-
25	8.0	28.6	25.5	20.7	Night.	-	-	-	-	-	5	Str.	10	Str.
26	23.5	30.0	30.0	27.8	-	3 P. M.	0.408	4.0	10	Nim.	10	Nim.	10	Str.
27	23.7	26.3	20.8	23.6	‡	-	-	-	3	Str.	7	Str.	5	Nim.
28	19.5	24.0	16.8	20.1	-	-	-	-	8	Str.	3	Str.	-	-
29	13.0	19.5	13.5	15.3	-	-	-	-	-	Str.	3	Str.	3	Str.
30	4.3	10.0	-2.5	3.9	-	-	-	-	-	-	-	-	-	-
31	3.0	28.2	27.0	19.4	-	-	-	-	7	Str.	8	Str.	10	Str.
	Mean,			18.3	Sums,		1.324	15.0	Mean,					5.0
	Max.			33.5										
	Min.			-5.0										

* A film of snow. † A few flakes. ‡ Little snow squalls.

JANUARY, 1867.—Continued.

WINDS.						BAROMETER.				FORCE OR PRESSURE OF VAPOR, IN INCHES.			RELATIVE HUMIDITY OR FRACTION OF SATURATION.			
7 A. M.		2 P. M.		9 P. M.		BAROMETER HEIGHT REDUCED TO FREEZING POINT.										
Direction.	Force.	Direction.	Force.	Direction.	Force.	7 A. M.	2 P. M.	9 P. M.	Mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Day of Month.
S. W.	1	S. W.	1	S. W.	1	29.920	29.882	29.923	29.908	.115	.166	.148	100	97	100	1
S. E.	1	S. E.	2	N.W.	1	29.961	29.918	29.899	29.926	.087	.127	.108	100	98	100	2
S.	2	S. E.	2	N.W.	2	29.895	29.905	29.890	29.897	.048	.086	.065	100	100	100	3
N.W.	2	N.W.	1	S. E.	1	29.850	29.833	29.837	29.840	.045	.089	.093	100	95	100	4
W.	1	W.	2	N.	3	29.810	29.626	29.430	29.622	.090	.131	.137	100	85	72	5
N.	3	N.	2	N.W.	2	29.199	29.259	29.293	29.250	.154	.144	.129	94	81	87	6
N.W.	2	N.W.	4	N.W.	3	29.357	29.325	29.321	29.334	.103	.096	.080	100	72	83	7
W.	2	N.W.	2	N.W.	1	29.250	29.158	29.182	29.197	.076	.077	.079	96	65	100	8
W.	1	N.W.	2	W.	2	29.210	29.179	29.211	29.200	.078	.081	.130	100	56	96	9
S. E.	3	N.W.	1	N.	2	29.223	29.175	29.219	29.206	.075	.115	.113	100	73	96	10
S. E.	2	N.W.	2	N.W.	1	29.357	29.432	29.595	29.461	.075	.107	.095	100	75	92	11
N.W.	2	N.W.	4	N.W.	2	29.710	29.764	29.861	29.778	.077	.081	.065	93	76	92	12
N.W.	2	N.W.	2	W.	1	29.793	29.623	29.526	29.647	.062	.127	.083	100	90	100	13
N.W.	2	N.	3	N.	3	29.487	29.495	29.544	29.475	.080	.064	.053	100	56	69	14
N.W.	4	N.W.	2	N.W.	3	29.542	29.564	29.749	29.618	.057	.061	.053	100	67	81	15
N.W.	2	S. E.	2	S. E.	1	29.880	29.854	29.725	29.820	.034	.050	.060	100	67	95	16
N.	4	N.	5	N	6	29.370	29.058	29.193	29.107	.071	.094	.095	100	100	100	17
N.W.	5	N.W.	4	N.W.	5	29.379	29.390	29.416	29.395	.068	.064	.048	100	100	100	18
N.W.	3	W.	3	N.W.	2	29.367	29.368	29.507	29.414	.044	.062	.068	100	89	100	19
S. E.	2	W.	1	E.	2	29.686	29.732	29.672	29.697	.055	.082	.085	100	84	89	20
N.	3	N.	2	N.	1	29.347	29.204	29.270	29.274	.116	.127	.129	100	100	100	21
N.W.	1	N.W.	2	N.W.	3	29.352	29.345	29.406	29.368	.096	.122	.108	100	77	78	22
N.W.	3	N.W.	3	N.W.	3	29.462	29.453	29.609	29.508	.112	.130	.130	92	78	89	23
N.W.	4	N.W.	3	N.W.	1	29.745	29.782	29.866	29.798	.133	.101	.098	83	52	100	24
N.W.	1	N.W.	2	E.	2	29.890	29.746	29.692	29.776	.062	.106	.102	100	70	74	25
N.W.	1	N.W.	1	S. E.	2	29.285	29.013	29.041	29.113	.126	.160	.148	100	100	89	26
N.W.	3	N.W.	3	N.W.	3	29.169	29.276	29.470	29.305	.126	.123	.098	100	87	89	27
N.W.	4	N.W.	4	W.	2	29.617	29.612	29.693	29.641	.092	.097	.094	87	76	100	28
N.W.	3	N.W.	4	N.W.	4	29.641	29.616	29.769	29.675	.078	.071	.075	100	69	96	29
N.W.	2	N.W.	1	W.	1	29.971	30.075	30.167	30.071	.052	.059	.038	100	89	100	30
S. W.	1	S.	3	S. E.	2	30.036	29.883	29.797	29.905	.047	.120	.141	100	82	100	31
Per cent. of Time and Force: N. W. & W. 67; S. W. & S. 4; S. E. & E. 11; N. E. & N. 18.						Mean, ... 29.556 Max. . . . . 30.167 Min. 29.013				Mean, . .092 Max. . . .166 Min. . . .034			Mean, . . 91 Max. . . 100 Min. . . 52			

FEBRUARY, 1867.

Day of Month.	THERMOMETER IN THE OPEN AIR. 7 A. M.	2 P. M.	9 P. M.	Mean.	RAIN AND SNOW. Time of begin'g of rain or snow.	Time of ending of rain or snow.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	CLOUDS. 7 A. M. Amount of cloudiness.	Kind of clouds.	2 P. M. Amount of cloudiness.	Kind of clouds.	9 P. M. Amount of cloudiness.	Kind of clouds.
1	34.5	48.3	37.0	39.9	–	–	–	–	7	Str.	6	Cir. & Cum.	–	–
2	21.0	37.0	35.0	31.0	Night.	–	–	–	2	Str.	9	Nim.	10	Nim.
3	34.0	39.0	36.3	36.3	–	6 A. M.	0.550	–	10	Nim.*	10	Fog,	10	Fog,
4	35.0	39.3	36.0	36.8	Night.	–	–	–	8	Str.	1	Str.	10	Nim.
5	35.0	40.0	37.7	37.6	–	10 A. M.	0.252	–	10	Nim.	9	Str.	10	Str.
6	30.0	40.7	29.0	33.2	–	–	–	–	7	Str.	5	Str.	–	–
7	21.3	38.0	29.7	29.7	–	–	–	–	–	–	2	Cir.	–	–
8	22.0	42.5	36.0	33.5	7 P. M.	–	–	–	–	–	7	Str.	10	Nim.
9	36.0	43.6	39.4	39.6	–	Night.	1.622	–	10	Nim.*	10	†	10	Nim.
10	25.0	19.2	7.3	17.2	–	–	–	–	7	Str.	7	Str.	–	–
11	8.0	26.1	24.0	19.4	–	–	–	–	–	–	7	Str.	3	Str.
12	27.4	37.8	36.0	33.7	–	–	–	–	8	Str.	8	Str.	7	Str.
13	32.0	47.7	42.8	40.8	–	–	–	–	1	Str.	5	Cir-St.	9	Str.
14	44.7	50.0	44.5	46.4	–	–	–	–	9	Str.	9	Str.	10	Str.
15	31.5	34.2	29.0	31.6	–	–	–	–	5	Str.	7	Str.	3	Cir.
16	27.5	33.0	33.0	31.2	7 A. M.	Night.	0.358	–	10	Str.	10	Nim.	10	Nim.
17	31.8	39.3	36.4	35.8	–	–	–	–	10	Str.	7	Str.	7	Str.
18	27.0	41.0	34.8	34.3	–	–	–	–	3	Str.	8	Str.	9	Str.
19	32.0	37.2	24.0	31.1	–	–	–	–	1	Str.	2	Str.	5	Str.
20	19.0	22.6	16.5	19.4	8½ A. M.	6 P. M.	0.107	1.0	10	Str.	10	Nim.	5	Str.
21	19.0	28.2	24.0	23.7	8 A. M.	Night.	0.395	5.0	10	Str.	10	Nim.	10	Nim.
22	24.0	36.0	26.0	28.7	–	–	–	–	8	Str.	8	Str.	2	Str.
23	9.0	28.1	23.2	20.1	8 P. M.	–	–	–	5	Str.	8	Str.	10	Nim.
24	27.8	42.8	29.7	33.4	–	8 A. M.	0.362	1.0	10	Nim.	8	Str.	–	–
25	20.2	28.8	19.0	22.7	–	–	–	–	4	Cir. & Str.	2	Cir.	–	–
26	9.0	35.1	29.8	28.0	–	–	–	–	2	Str.	5	Str.	–	–
27	22.9	35.3	24.5	27.6	–	–	–	–	–	–	1	Cu-str.	–	–
28	18.0	40.9	36.3	31.7	–	–	–	–	8	Str.	8	Str.	8	Str.
	Mean, 31.23 Max. 50.0 Min. 8.0				Sums,		3.646	7.0	Mean,					6.3

* Fog. † Fog and Mist.

FEBRUARY, 1867.—Continued.

WINDS.						BAROMETER.				FORCE OR PRESSURE OF VAPOR, IN INCHES.			RELATIVE HUMIDITY OR FRACTION OF SATURATION.			
7 A. M.		2 P. M.		9 P. M.		BAROMETER HEIGHT REDUCED TO FREEZING POINT.										
Direction.	Force.	Direction.	Force.	Direction.	Force.	7 A. M.	2 P. M.	9 P. M.	Mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Day of Month.
S. E.	3	W.	2	N.W.	3	29.396	29.339	29.582	29.439	.183	.239	.145	93	72	69	1
N.W.	1	S. E.	2	E.	2	29.709	29.645	29.466	29.607	.112	.139	.199	100	64	98	2
N.W.	1	S. E.	1	S. E.	1	29.106	29.073	29.128	29.102	.196	.236	.212	100	100	100	3
N.W.	4	W.	2	S. E.	2	29.389	29.577	29.618	29.528	.146	.158	.197	72	66	95	4
N.W.	1	S. W.	3	W.	4	29.229	29.301	29.482	29.337	.204	.207	.174	100	84	78	5
S. W.	1	N.W.	4	N.W.	1	29.741	29.758	29.931	29.810	.135	.160	.147	81	64	94	6
S. E.	1	S.	2	S. E.	1	30.113	30.126	30.173	30.137	.113	.162	.160	100	73	100	7
S. W.	1	S. W.	1	–	–	30.108	29.996	29.818	29.974	.118	.194	.209	100	73	100	8
S. W.	1	S. W.	1	S.	3	29.452	29.363	29.235	29.350	.210	.278	.241	100	100	100	9
N.W.	5	N.W.	6	N.W.	4	29.208	29.677	30.210	29.708	.111	.075	.060	83	74	100	10
W.	2	S.	3	S.	4	30.584	30.561	30.494	30.546	.062	.108	.118	100	78	91	11
S.	3	S. E.	3	S. E.	2	30.354	30.272	30.245	30.290	.147	.145	.192	100	65	93	12
S.	1	S. E.	4	S.	3	30.174	30.047	29.920	30.047	.180	.267	.275	100	83	100	13
S. E.	1	S. W.	1	N.W.	1	29.809	29.843	29.907	29.853	.295	.295	.257	99	83	89	14
N.W.	3	S. W.	2	N.W.	1	30.072	30.124	30.204	30.133	.131	.109	.123	76	56	81	15
N.	2	E.	1	E.	1	30.098	29.835	29.531	29.821	.147	.187	.188	100	100	100	16
S. E.	1	N.W.	5	N.W.	5	29.492	29.578	29.696	29.589	.179	.157	.145	100	65	69	17
N.W.	1	S. W.	2	S.	1	29.789	29.731	29.660	29.727	.138	.149	.167	97	60	84	18
N.W.	1	W.	3	N. E.	3	29.640	29.762	29.948	29.783	.171	.138	.087	96	64	69	19
N. E.	2	N. E.	2	N.W.	1	29.932	29.851	29.970	29.918	.088	.114	.090	88	97	100	20
N.W.	1	S. E.	2	N. E.	2	29.922	29.796	29.622	29.780	.101	.140	.129	100	90	100	21
N.W.	3	N.W.	3	N.W.	4	29.655	29.682	29.804	29.714	.129	.156	.113	100	75	78	22
S. E.	1	N.W.	1	S. E.	2	29.974	29.846	29.718	29.846	.064	.105	.124	100	71	100	23
W.	1	W.	3	W.	1	29.299	29.385	29.600	29.428	.152	.192	.160	100	72	100	24
N.W.	2	N.W.	2	N.W.	1	29.867	29.864	29.886	29.872	.094	.082	.098	88	53	100	25
S. W.	2	N.W.	2	N.W.	4	29.855	29.868	29.935	29.886	.064	.123	.138	100	62	86	26
N.W.	1	N.W.	3	W.	1	29.984	29.966	30.066	30.005	.106	.127	.086	90	62	69	27
S. W.	1	S. W.	3	S. W.	1	30.099	29.871	29.795	29.920	.093	.148	.191	96	60	90	28
Per cent. of Time and Force: N. W. & W. 53; S. W. & S. 22; S. E. & E. 19; N. E. & N. 6.						Mean, 29.791 Max. 30.584 Min. 29.073				Mean, .152 Max. .295 Min. .060			Mean, 86 Max. 100 Min. 53			

MARCH, 1867.

Day of Month.	Thermometer in the open air. 7 A. M.	2 P. M.	9 P. M.	Mean.	Rain and Snow. Time of begin'g of rain or snow.	Time of ending of rain or snow.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Clouds. 7 A. M. Amount of cloudiness.	Kind of clouds.	2 P. M. Amount of cloudiness.	Kind of clouds.	9 P. M. Amount of cloudiness.	Kind of clouds.
1	32.0	33.9	31.2	32.4	1 P. M.	–	–	–	8	Str.	10	Nim.	10	Nim.
2	33.3	44.0	28.5	35.3	–	6 A. M.	0.170	–	10	Nim.	7	Str.	2	Str.
3	12.0	23.4	23.0	19.5	Night.	–	–	–	1	Str.	7	Str.	10	Str.
4	19.0	31.0	28.0	26.0	–	3 P. M.	0.645	5.0	10	Nim.	10	Nim.	10	Str.
5	27.4	36.3	20.7	28.1	–	–	–	–	9	Str.	3	Cir.	–	–
6	15.8	32.9	28.7	25.8	Night.	–	–	–	9	Str.	10	Str.	10	Str.
7	26.0	26.8	26.8	26.5	-	7 P. M.	0.478	2.0	10	Nim.	10	Nim.	10	Nim.
8	25.0	36.0	30.0	30.3	–	–	–	–	2	Str.	2	Str.	–	–
9	19.0	42.0	34.5	31.8	–	–	–	–	8	Str.	8	Str.	10	Str.
10	32.2	37.0	34.8	34.7	9 A. M.	Night.	0.475	–	10	Str.	10	Nim.	10	Nim.
11	34.2	46.3	37.0	39.2	–	–	–	–	10	Str.	5	Str.	2	Str.
12	34.0	36.9	33.4	34.8	5½ A. M.	6 P. M.	0.230	–	10	Nim.	10	Nim.	9	Str.
13	32.0	41.3	34.7	36.0	*	–	–	–	10	Str.	10	Str.	10	Nim.
14	26.0	26.3	16.3	22.9	–	–	–	–	9	Str.	7	Str.	–	–
15	10.6	26.0	20.7	19.1	–	–	–	–	–	–	2	Str.	2	Str.
16	14.2	29.6	24.0	22.6	4 P. M.	–	–	–	7	Cir. & Str.	10	Str.	10	Nim.
17	21.5	26.8	23.8	24.0	–	5 P. M.	0.650	7.0	10	Nim.	10	Nim.	8	Str.
18	21.4	25.0	21.5	22.6	–	–	–	–	3	Str.	2	Str.	8	Str.
19	18.0	34.6	21.0	24.5	–	–	–	–	–	–	–	–	–	–
20	8.0	39.0	31.8	26.3	–	–	–	–	1	Str.	1	Str.	3	Haze.
21	29.0	44.0	36.0	36.3	–	–	–	–	9	Str.	10	Str.	8	Str.
22	32.0	35.0	34.0	33.7	–	–	–	–	8	Str.	10	Str.	10	Str.
23	31.8	40.0	31.3	34.4	–	–	–	–	8	Str.	7	Str.	8	Str.
24	30.5	44.3	35.0	36.6	Night.	–	–	–	9	Str.	8	Str.	10	Str.
25	34.0	46.0	38.7	39.6	–	10 A. M.	0.467	–	10	Nim.	8	Str.	9	Str.
26	30.3	38.2	30.7	33.1	–	–	–	–	–	Str.	–	–	–	–
27	27.0	39.7	34.6	33.8	–	–	–	–	8	Str.	9	Str.	9	Str.
28	31.3	38.2	32.0	33.8	–	–	–	–	10	Str.	8	Str.	1	Str.
29	27.6	33.8	29.0	30.1	–	–	–	–	1	Str.	4	Str.	1	Str.
30	30.5	45.0	40.0	38.5	–	–	–	–	1	Str.	3	Str.	7	Str.
31	35.7	53.0	42.5	43.7	–	–	–	–	1	Str.	–	–	–	–
	Mean, 30.84 Max. 53.0 Min. 8.0				Sums,		3.115	14.0	Mean,					63

* Mist, Evening.

MARCH, 1867—Continued.

WINDS.						BAROMETER.				FORCE OR PRESSURE OF VAPOR. In Inches.			RELATIVE HUMIDITY OR FRACTION OF SATURATION.			Day of Month.
7 A. M.		2 P. M.		9 P. M.		BAROMETER HEIGHT REDUCED TO FREEZING POINT.										
Direction.	Force.	Direction.	Force.	Direction.	Force.	7 A. M.	2 P. M.	9 P. M.	Mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	
W.	1	N. E.	3	N.	3	29.830	29.695	29.399	29.641	.179	.173	.174	100	89	100	1
S. E.	3	W.	2	N.W.	5	29.093	29.075	29.399	29.189	.189	.279	.144	100	97	91	2
N.	3	N.	2	N.	1	29.852	29.884	29.869	29.868	.067	.076	.115	90	62	94	3
N.	1	N.W.	2	N.W.	1	29.637	29.640	29.723	29.667	.103	.146	.152	100	86	100	4
N.W.	1	N.W.	1	[illegible]	1	29.926	29.960	30.080	29.989	.147	.153	.108	100	73	100	5
S. E.	1	N.W.	2	S. E.	2	30.206	30.221	30.182	30.203	.086	.120	.155	100	66	100	6
N.	1	N. E.	2	N.	3	29.966	29.743	29.849	29.853	.141	.143	.138	100	100	97	7
S. E.	1	N.	3	N.W.	3	30.063	30.136	30.181	30.127	.131	.129	.132	100	61	81	8
N.W.	2	S.	3	S.	1	30.189	30.099	30.133	30.140	.101	.168	.190	100	65	77	9
N. E.	2	N. E.	1	N. E.	1	30.092	29.964	29.776	29.944	.181	.197	.200	100	91	100	10
W.	2	W.	1	N.W.	2	29.598	29.787	29.782	29.722	.198	.218	.191	100	71	90	11
N.W.	1	N. E.	1	–	–	29.750	29.602	29.625	29.659	.195	.222	.182	100	100	96	12
S.	1	S. E.	2	S. E.	1	29.703	29.633	29.548	29.628	.180	.214	.204	100	84	100	13
N.W.	4	N.W.	4	N.W.	5	29.601	29.715	29.868	29.728	.105	.104	.075	75	77	85	14
S. E.	2	S. W.	2	S. E.	1	30.099	30.114	30.130	30.114	.068	.094	.090	100	68	84	15
S. E.	1	N. E.	3	N. E.	2	30.192	29.993	29.821	30.002	.083	.097	.128	100	60	100	16
N.	2	N.	2	N.W.	1	29.454	29 290	29.267	29.340	.114	.141	.128	100	100	100	17
N.W.	5	N.W.	6	N.W.	3	29,467	29.583	29.696	29.582	.109	.097	.096	96	75	85	18
N.W.	2	N.W.	2	S. E.	1	29.829	29.849	29.990	29.889	.089	.162	.095	92	84	88	19
S. W.	1	N. E.	2	N. E.	2	30.104	30.097	30.153	30.118	.060	.099	.120	100	43	68	20
N. E.	1	N. E.	3	N. E.	2	30.146	30.068	29.976	30.063	.142	.171	.152	88	60	73	21
N. E.	3	N. E.	4	N. E.	4	29.852	29.852	29.955	29.886	.147	.157	.151	82	78	77	22
N. E.	4	N. E.	3	N. E.	3	30.029	30.051	30.102	30.061	.145	.182	.150	82	73	86	23
N.W.	1	E.	1	E.	2	30.063	29.992	29.909	29.988	.161	.193	.201	95	69	100	24
E.	1	S. E.	1	W.	2	29.785	29.731	29.775	29.764	.196	.263	.186	100	88	79	25
N.W.	3	N.W.	3	N.W.	3	29.815	29 750	29.747	29.771	.135	.126	.130	81	56	78	26
S. W.	1	S. E.	2	S. E.	1	29.625	29.496	29.396	29.506	.125	.141	.186	85	61	95	27
N.	3	N.W.	2	N.W.	2	29.276	29.223	29.308	29.269	.141	.160	.141	81	70	79	28
W.	3	N.W.	4	N.W.	4	29.315	29.222	29.224	29.287	.107	.094	.105	73	50	67	29
S.	1	N.W.	4	N.W.	4	29.238	29.204	29.264	29.235	.126	.144	.164	76	49	66	30
S. W.	1	N.W.	3	W.	2	29.324	29.362	29.476	29.387	.174	.191	.182	83	48	68	31
Per cent. of Time and Force: N. W. & W. 48; S. W. & S. 5; S. E. & E. 12; N. E. & N. 35.						Mean, 29.762 Max. 30.221 Min. 29.075				Mean, .146 Max. .279 Min. .060			Mean, 84 Max. 100 Min. 43			

APRIL, 1867.

Day of Month.	Thermometer in the open air. 7 A. M.	2 P. M.	9 P. M.	Mean.	Rain and snow. Time of begin'g of rain or snow.	Time of ending of rain or snow.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Clouds. 7 A. M. Amount of cloudiness.	Kind of clouds.	2 P. M. Amount of cloudiness.	Kind of clouds.	9 P. M. Amount of cloudiness.	Kind of clouds.
1	35.1	41.0	36.8	37.6	9 A. M.	3 P. M.	0.350	–	8	Str.	10	Nim.	9	Str.
2	41.9	49.0	38.5	43.1	–	–	–	–	8	Str.	2	Cu-str.	5	Str.
3	36.0	48.0	37.5	40.5	–	–	–	–	–	Str.	–	–	–	–
4	34.5	62.3	47.0	47.9	–	–	–	–	7	Str.	[illegible]	Smoke,	3	Str.
5	47.0	41.8	40.8	43.2	8 A. M.	4 P. M.	0.266	–	10	Str.	10	Nim.	7	Str.
6	36.0	40.0	33.8	36.6	–	–	–	–	2	Str.	5	Str.	–	–
7	36.0	59.0	43.5	46.2	–	–	–	–	5	Str.	3	Str.	6	Str.
8	38.8	58.4	53.5	50.2	–	–	–	–	9	Str.	6	Str.	8	Str.
9	41.9	53.0	41.0	50.4	–	–	–	–	–	–	–	–	5	Str.
10	41.8	55.5	45.9	47.7	6 P. M.	Night.	0.375	–	5	Str.	10	Str.	10	Nim.
11	42.0	52.0	38.0	44.0	–	–	–	–	8	Str.	5	Cu-str.	1	Cir.
12	36.5	59.4	42.0	46.0	–	–	–	–	–	–	1	Cir.	5	Str.
13	37.7	53.0	38.9	43.2	–	–	–	–	7	Str.	5	Cu-str.	–	–
14	29.0	53.3	42.0	41.4	–	–	–	–	–	Str.	1	Str.	8	Str.
15	42.2	66.0	57.0	55.1	Night.	–	–	–	10	Str.	7	Str.	7	Str.
16	54.6	56.0	54.7	55.1	–	–	–	–	10	Nim.	10	Nim.	10	–
17	48.0	50.3	46.0	48.1	–	5 P. M.	1.325	–	9	Nim.	9	Nim.	–	–
18	43.5	49.9	39.8	44.4	–	–	–	–	–	–	4	Str.	–	–
19	40.5	58.0	47.8	48.8	–	–	–	–	3	Str.	–	Str.	3	Str.
20	47.1	58.0	48.0	51.4	*	Night.	0.326	–	3	Cir.	6	Str.	9	Nim.
21	48.0	58.0	47.0	51.0	–	–	–	–	10	Fog,	7	Cu-str.	2	Str.
22	42.8	55.3	49.0	49.0	10 A. M.	8 P. M.	0.581	–	8	Str.	9	Nim.	–	–
23	43.0	–	36.0	–	–	–	–	–	2	Str.	3	Cu-str.	–	Str.
24	37.0	38.2	37.3	37.5	11 A. M.	Night.	0.085	–	9	Str.	10	Nim.	10	Nim.
25	41.4	52.2	42.0	45.2	–	–	–	–	3	Str.	2	Cir.	2	Str.
26	38.5	60.0	46.8	48.4	–	–	–	–	–	–	2	Cu-str.	3	Str.
27	45.2	48.0	37.5	43.6	1½ P. M.	4 P. M.	0.158	–	2	Str.	10	Nim.	–	–
28	33.0	46.0	39.0	39.3	–	–	–	–	–	–	2	Cir.	–	–
29	36.0	52.0	39.2	42.4	2 P. M.	–	–	–	1	Cir.	9	Nim.	10	Nim.
30	40.7	49.9	50.0	46.9	–	–	0.325	–	10	Nim.	10	Nim.	10	Nim.
	Mean, . . 45.49 Max. . . 66.0 Min. . . 29.0				Sum, . . . 3.791			–	Mean, ... 4.9					

* Shower.

APRIL, 1867.—CONTINUED.

WINDS.						BAROMETER. Barometer height reduced to freezing point.				FORCE OR PRESSURE OF VAPOR, IN INCHES.			RELATIVE HUMIDITY OR FRACTION OF SATURATION.			
7 A. M.		2 P. M.		9 P. M.												
Direction.	Force.	Direction.	Force.	Direction.	Force.	7 A. M.	2 P. M.	9 P. M.	Mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Day of Month.
S. W.	2	E.	1	E.	1	29.321	29.186	29.192	29.566	.187	.247	.218	92	96	100	1
W.	3	N.W.	5	N.W.	5	29.260	29.296	29.513	29.056	.203	.185	.165	76	53	72	2
N.W.	5	N.W.	4	S. W.	1	29.751	29.848	29.925	29.872	.141	.116	.157	67	35	71	3
S. E	1	S.	4	S.	3	29.885	29.595	29.519	29.666	.190	.284	.261	97	51	81	4
S.	3	N. E.	2	W.	3	29.348	29.157	29.210	29.238	.319	.264	.207	100	100	82	5
S. W.	2	N.W.	4	N.W.	1	29.213	29.384	29.613	29.403	.200	.153	.119	94	62	62	6
S. E.	3	S. W.	5	S. E.	2	29.696	29.548	29.761	29.668	.153	.182	.209	73	38	75	7
N.W.	1	N.W.	2	W.	3	29.871	29.663	29.663	29.732	.202	.377	.257	86	59	63	8
N.W.	1	S. W.	2	S. W.	1	29.873	29.897	29.968	29.913	.161	.146	.253	60	38	100	9
S.	2	S.	3	S. E.	3	29.771	29.573	29.349	29.564	.212	.267	.305	82	62	100	10
N.W.	4	N.W.	4	N.W.	3	29.226	29.340	29.553	29.373	.254	.211	.149	95	55	65	11
S. E.	1	N.W.	3	E.	1	29.623	29.511	29.507	29.580	.165	.190	.209	78	38	80	12
S. E.	1	N. E.	2	N.	3	29.612	29.642	29.890	29.715	.216	.194	.097	97	50	42	13
N.W.	1	S. E.	2	S.	3	30.109	30.055	30.063	30.076	.132	.177	.206	85	44	78	14
S. E.	1	S.	3	S.	4	29.943	29.713	29.683	29.780	.232	.380	.360	87	61	79	15
S.	2	S.	3	S.	1	29.585	29.444	29.330	29.453	.421	.442	.424	100	100	100	16
N. E.	3	N. E.	3	N.W.	1	29.315	29.403	29.650	29.456	.305	.298	.278	91	82	92	17
N.W.	2	N.W.	4	N.	4	29.625	29.700	29.808	29.711	.240	.143	.150	86	41	63	18
N.	3	N.	3	N.	1	29.895	29.832	29.821	29.849	.097	.114	.208	39	24	67	19
S. E.	1	S. W.	4	S.	3	29.796	29.673	29.660	29.710	.232	.170	.200	73	36	59	20
S. W.	1	W.	4	N.W.	2	29.425	29.416	29.500	29.447	.334	.233	.226	100	49	72	21
S.	3	S. W.	2	N.W.	2	29.456	29.200	29.174	29.277	.253	.321	.341	94	74	100	22
N.W.	3	N.W.	3	N.W.	2	29.521	–	29.875		.195	–	.162	70	–	78	23
N. E.	2	S. E.	2	S. E.	1	29.965	29.963	29.897	29.942	.156	.228	.219	71	100	100	24
S. E.	2	N.W.	3	N.W.	2	29.878	29.864	29.905	29.882	.257	.204	.233	100	52	87	25
S. E.	1	S. W.	2	S. E.	2	29.945	29.817	29.805	29.889	.225	.190	.241	97	38	78	26
S. E.	3	S.	3	N.W.	4	29.679	29.563	29.717	29.653	.258	.289	.170	86	89	76	27
N.W.	3	N.	3	N. E.	2	29.900	29.923	29.962	29.928	.124	.130	.126	67	43	56	28
S. E.	1	S. E.	3	S. E.	2	30.058	29.994	29.973	30.008	.174	.188	.238	84	50	100	29
N.W.	1	N.	1	N.	1	29.858	29.742	29.637	29.746	.245	.346	.361	98	99	100	30

Per cent. of Time and Force: N. W. & W. 40; S. W. & S. 28; S. E. & E. 16; N. E. & N. 16.

Barometer: Mean, 29.598; Max. 30.109; Min. 29.157

Force of vapor: Mean, .224; Max. .442; Min. .097

Relative humidity: Mean, 74; Max. 100; Min. 24

MAY, 1867.

Day of Month.	Thermometer in the open air. 7 A. M.	2 P. M.	9 P. M.	Mean.	Rain and snow. Time of begin'g of rain or snow.	Time of ending of rain or snow.	Amount of rain or melted snow in gauge, inches.	Depth of snow, inches.	Clouds. 7 A. M. Amount of cloudiness.	Kind of clouds.	2 P. M. Amount of cloudiness.	Kind of clouds.	9 P. M. Amount of cloudiness.	Kind of clouds.
1	52.5	58.7	48.9	53.4	*	Noon.	0.313 0.498	–	10	Nim.	9	Nim.	9	Nim.
2	46.0	56.0	39.4	47.1	–	–	–	–	1	Cu-str.	3	Cum.	–	–
3	36.0	48.2	38.5	40.9	–	–	–	–	1	Str.	–	–	–	–
4	38.0	55.0	40.0	44.3	–	–	–	–	–	–	–	Cir.	–	–
5	40.7	55.0	46.0	47.2	–	–	–	–	4	Str.	9	Str.	10	Str.
6	46.0	66.3	51.8	54.7	–	–	–	–	10	Str.	7	Str.	10	Str.
7	51.0	52.8	52.0	51.9	†	–	–	–	10	Str.	10	Nim.	9	Str.
8	49.9	58.7	48.2	52.3	–	–	–	–	10	Nim.	10	Nim.	10	Str.
9	45.0	57.0	49.0	50.3	–	11½ A.M.	0.730	–	10	Nim.	6	Cu-str.	2	Str.
10	51.1	63.2	52.1	55.5	–	–	–	–	8	Str.	8	Cu-str.	2	Str.
11	53.4	64.2	52.0	56.5	–	–	–	–	–	Str.	3	Cu-str.	3	Cir.
12	51.0	57.2	48.0	52.1	–	–	–	–	–	Str.	8	Cu-str.	–	–
13	46.0	65.3	52.3	54.5	5 P. M.	–	–	–	–	Str. & Cir.	2	Str. & Cir.	10	Nim.
14	49.2	57.0	50.0	52.1	6 P. M.*	6 A. M.	0.877 0.140	–	10	Str.	10	Str.	9	Str.
15	49.5	57.8	47.1	51.5	P. M.‡	–	–	–	10	Str.	9	Cu-str.	8	Str.
16	48.0	57.2	49.2	51.5	–	–	–	–	4	Str.	3	Cu-str.	2	Str.
17	53.1	61.0	49.7	54.6	‡	–	–	–	4	Cir.	8	Str.	3	Str.
18	54.0	59.0	50.0	54.3	‡	–	–	–	3	Str.	7	Cu-str.	5	Str.
19	51.0	60.5	52.7	54.7	Night.	–	–	–	–	Str.	6	Cu-str.	9	Str.
20	50.4	55.8	51.0	52.4	–	Noon.	0.370	–	10	Nim.	10	Nim.	5	Str.
21	47.2	65.0	49.0	53.5	–	–	–	–	5	Fog,	7	Cu-str.	1	Str.
22	49.5	50.4	47.0	49.0	9½ A. M.	1 P. M.	0.372	–	10	Str.	10	Nim.	10	Str.
23	51.7	61.0	53.7	55.5	*	–	0.042	–	9	Str.	7	Cu-str.	6	Str.
24	50.2	59.8	50.6	53.5	–	–	–	–	7	Str.	7	Cu-str.	–	–
25	51.3	71.8	58.0	60.4	Night.	–	–	–	–	Cir.	2	Cum.	10	Str.
26	57.0	68.0	56.0	60.3	–	Night.	1.048	–	10	Nim.	9	Str.	10	Nim.
27	54.8	70.8	57.8	61.1	–	–	–	–	–	–	1	Cir. & Cum.	1	Str.
28	60.0	75.5	66.5	67.3	Night.	–	–	–	8	Str.	2	Cir.	10	Str.
29	59.1	65.7	58.0	60.9	–	3 P. M.	0.220	–	10	Nim.	10	Nim.	9	Str.
30	58.0	70.8	58.0	62.3	‡	–	–	–	5	Str.	8	Cu-str.	8	Str.
31	53.0	68.0	58.5	59.8	‡	–	–	–	9	Str.	8	Cu-str.	–	–
	Mean, . . 54.05 Max. . . 75.5 Min. . . 36.0				Sum, . . . 4.610			–	Mean, ... 5.9					

* Shower. † A few drops in night. ‡ Sprinkles.

MAY, 1867.—Continued.

WINDS.						BAROMETER. Barometer height reduced to freezing point.				FORCE OR PRESSURE OF VAPOR, In Inches.			RELATIVE HUMIDITY OR FRACTION OF SATURATION.			
7 A. M.		2 P. M.		9 P. M.												
Direction.	Force.	Direction.	Force.	Direction.	Force.	7 A. M.	2 P. M.	9 P. M.	Mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Day of Month.
S. E.	2	S. E.	4	W.	3	29.340	29.111	29.047	29.166	.393	.509	.303	100	100	89	1
N.W.	4	N.W.	5	N.W.	2	29.538	29.666	29.902	29.702	.213	.141	.152	69	32	63	2
N.W.	2	N.W.	2	S. E.	3	30.116	30.085	30.133	30.111	.124	.130	.175	60	40	76	3
N.W.	1	S.W.	2	S. E.	3	30.223	30.129	30.102	30.151	.192	.185	.145	86	44	60	4
S. E.	2	S. E.	4	S.	4	30.020	29.980	29.840	29.913	.198	.257	.246	80	61	80	5
S. E.	2	S. W.	3	S. E.	2	29.797	29.691	29.680	29.723	.307	.348	.348	100	56	96	6
S. E.	2	N.W.	2	S. E.	1	29.581	29.521	29.471	29.519	.348	.380	.362	93	96	93	7
N.	2	N. E.	2	S. E.	4	29.211	29.031	29.042	20.095	.355	.480	.246	99	99	68	8
S. E.	3	N.W.	3	W.	2	28.991	29.101	29.286	29.126	.287	.315	.266	97	68	78	9
S. W.	2	S. W.	3	S. W.	1	29.380	29.360	29.454	29.398	.296	.265	.239	79	47	63	10
S. E.	1	N.W.	2	N.W.	1	29.518	29.485	29.566	29.523	.293	.220	.194	73	37	52	11
E.	1	N.W.	4	N.W.	1	29.653	20.625	29.726	29.668	.299	.216	.215	81	46	66	12
S. E.	1	S. W.	1	S. W.	3	29.789	29.646	29.576	29.670	.260	.255	.264	84	42	69	13
N. E.	1	W.	2	W.	1	29.336	29.232	29.282	29.283	.348	428	.359	100	94	99	14
S. E.	2	S. W.	3	W.	1	29.263	20.192	29.272	29.242	.357	.356	.306	100	75	96	15
N.W.	2	N.W.	4	W.	1	29.344	29.415	29.528	29.429	.269	.295	.255	81	63	73	16
S E.	1	W.	2	N.	1	29.551	29.503	29.524	29.526	.285	325	.294	71	61	84	17
N.W.	2	N.	4	N.W.	3	29.503	29.605	29.714	29.637	.302	.248	.252	73	49	71	18
W.	2	N.	2	N.	1	29.779	29.721	29.709	29.736	.310	.277	.308	87	53	79	19
S. E.	2	S. E.	3	N. E.	2	29.664	29.596	29.601	29.620	.361	.376	.340	100	87	93	20
N.W.	1	S. E.	3	S. E.	2	29.594	29.515	29.470	29.526	.323	.387	.255	100	65	74	21
N. E.	3	N. E.	2	N.	1	29.330	29.264	29.315	29.303	.272	.335	.321	78	93	100	22
S. E.	2	S. W.	3	W.	2	29.338	29.330	29.429	29.366	.364	.366	.291	96	71	71	23
W.	1	W.	4	W.	1	29.551	29.615	29.810	29.659	.337	.303	.295	94	59	83	24
S. E.	1	S. W.	4	S.	3	29.833	29.751	29.758	29.781	.308	.362	.280	82	47	59	25
S.	3	S. W.	4	S.	1	29.631	29.532	29.588	29.584	.463	.556	.441	100	84	100	26
N.W.	1	W.	1	S. W.	1	29.724	29.711	29.755	29.730	.369	.387	.387	90	54	84	27
N.W.	2	S. W.	3	S.	3	29.813	29.709	29.685	29.736	.415	.497	.460	82	59	73	28
N.	1	E.	1	N. E.	3	29.593	29.605	29.634	29.611	.500	.500	.424	100	81	88	29
S. E.	2	W.	3	N.	1	29.621	29.530	29.564	29.572	.459	.565	.342	96	78	91	30
N.	1	N.W.	4	N.	1	29.541	29.577	29.733	29.617	.360	.344	.337	92	51	70	31
Per cent. of Time and Force: N. W. & W. 36; S. W. & S. 23; S. E. & E. 27; N. E. & N. 14.						Mean, . . . 29.571 Max. . . . 30.223 Min. . . . 28.991				Mean, . .319 Max. . . .565 Min. . . .124			Mean, . . 76 Max. . . 100 Min. . . 32			

JUNE, 1867.

Day of Month.	THERMOMETER IN THE OPEN AIR. 7 A. M.	2 P. M.	9 P. M.	Mean.	RAIN AND SNOW. Time of begin'g of rain or snow.	Time of ending of rain or snow.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	CLOUDS. 7 A. M. Amount of cloudiness.	Kind of clouds.	2 P. M. Amount of cloudiness.	Kind of clouds.	9 P. M. Amount of cloudiness.	Kind of clouds.
1	56.3	74.9	62.0	64.4	–	–	–	–	2	Str.	7	Str.	5	Str.
2	62.0	69.8	60.0	63.9	4 P. M.	–	–	–	2	Str.	9	Str.	10	Nim.
3	63.0	76.7	65.3	68.3	–	8 A. M.	1.053	–	10	Nim.	8	Cu.str	7	Str.
4	65.0	68.3	61.3	64.9	–	–	–	–	2	Str.	6	Cu-str.	–	–
5	61.0	76.0	61.5	66.2	–	–	–	–	–	–	1	Cum.	–	–
6	59.0	85.0	69.0	71.0	–	–	–	–	2	Cir.	4	Cir. & Cum.	–	–
7	70 3	84.0	62.2	72.2	*5 P. M.	7 P. M.	1.669	–	1	Str.	5	Cir. & Cum.	10	Str.
8	59.8	60.2	54.2	58.1	–	–	–	–	10	Str.	10	Str.	10	Str.
9	55.5	67.3	57.5	60.1	–	–	–	–	7	Str.	7	Str.	–	–
10	55.6	71.0	51.0	59.2	–	–	–	–	–	Str.	4	Cum.	2	–
11	54.0	75.0	59.0	62.7	–	–	–	–	–	Str.	1	Cir. & Cum.	–	–
12	57.5	74.5	65.0	65.7	†	–	–	–	3	Cir.	1	Cir.	10	Nim.
13	66.7	83.0	68.4	72.7	–	–	–	–	1	Str.	4	Cum.	1	Cir.
14	66.8	79.0	61.2	69.0	–	–	–	–	–	Cir.	2	Cum.	–	–
15	60.9	78.8	68.1	69.3	8 P. M.	–	–	–	7	Str.	7	Str.	10	Str.
16	67.0	–	66.8	–	–	–	–	–	10	Str.	–	–	9	Str.
17	68.6	73 8	68.5	70.3	–	–	–	–	10	Str.	10	Str.	10	Nim.
18	67.8	72.8	64.8	68.5	2½ P. M.	8 A.M. Night.	1.135 1.215	–	10	Min.	10	Str.	10	Nim.
19	59 8	73.1	61.1	64.6	–	–	–	–	8	Str.	2	Cu-str.	1	Str.
20	59.8	77.0	64.8	67.2	–	–	–	–	5	Cir. & Str.	8	Str. & Cum.	9	Str.
21	63.0	76.8	66.5	68.8	–	–	–	–	7	Str.	7	Cu-str.	8	Str.
22	62.8	78.0	63.3	68.0	–	–	–	–	1	Cir.	–	Cum	1	Cir.
23	62.0	77.7	68.4	69.4	–	–	–	–	1	Str.	1	Str.	3	Str.
24	66.0	82.8	68.9	72.6	†	Night.	–	–	10	Str.	1	Cum.	6	Str.
25	63.0	67.2	60.0	63.4	–	–	–	–	10	Str.	9	Str.	10	Str.
26	59.1	72.5	61.8	64.5	Night.	–	–	–	2	Cir.	3	Cir. & Str.	8	Str.
27	59.0	64.7	64.4	62.7	–	Night.	0.600	–	10	Str. & Nim.	10	Nim.	10	Str.
28	68.4	81.2	66.2	71.9	–	–	–	–	10	Str.	3	Cu-str.	–	–
29	63.7	79.2	67.6	70.2	–	–	–	–	–	Str.	1	Str.	1	Str.
30	64.6	84.1	76.0	74.9	–	–	–	–	2	Cir.	2	Cir.	–	–
	Mean, . . 67.06 Max. . . 85.0 Nim. . . 54.0				Sum, . .		5.672	–	Mean, ...					4.9

* Thunder Shower.

† Sprinkle.

JUNE, 1867.—Continued.

Winds. 7 A. M. Direction.	7 A. M. Force.	2 P. M. Direction.	2 P. M. Force.	9 P. M. Direction.	9 P. M. Force.	Barometer height reduced to freezing point. 7 A. M.	2 P. M.	9 P. M.	Mean.	Force or Pressure of Vapor, in Inches. 7 A. M.	2 P. M.	9 P. M.	Relative Humidity or Fraction of Saturation. 7 A. M.	2 P. M.	9 P. M.	Day of Month.
S. E.	1	S. W.	2	E.	1	29.848	29.777	29.789	29.805	.401	.392	.415	92	48	77	1
S. E.	3	S. E.	4	S. E.	2	29.793	29.696	29.625	29.705	.417	.499	.518	79	71	100	2
S. E.	3	S. W.	3	W.	1	29.384	29.306	29.323	29.338	.576	.762	.618	100	86	100	3
S. E.	1	W.	4	N.W.	2	29.374	29.448	29.568	29.463	.550	.433	.426	92	63	82	4
N.W.	1	N.W.	2	N.W.	1	29.687	29.665	29.725	29.692	.428	.345	.347	82	40	64	5
N.W.	1	S. W.	3	N.W.	1	29.761	29.628	29.642	29.677	.433	.623	.588	87	53	85	6
S. E.	2	S. E.	4	N. E.	2	29.659	29.600	29.711	29.657	.624	.820	.556	86	74	100	7
N. E.	3	N. E.	3	N.	3	29.823	29.812	29.854	29.830	.383	.396	.324	76	76	78	8
N.	3	N. E.	3	N. E.	1	29.788	29.780	29.854	29.801	.396	.347	.321	92	54	74	9
W.	1	E.	2	S. E.	2	29.930	29.936	29.994	29.956	.362	.466	.309	84	63	85	10
S. E.	1	S. E.	1	S. E.	3	30.016	29.935	29.924	29.958	.348	.532	.350	83	63	70	11
S. E.	3	S. E.	4	S.	1	29.875	29.728	29.704	29.769	.434	.568	.586	94	67	97	12
S. E.	1	W.	4	W.	1	29.690	29.645	29.724	29.686	.614	.594	.469	95	55	68	13
W.	2	S. W.	2	S.	2	29.848	29.813	29.858	29.840	.563	.576	.396	88	60	74	14
S. E.	2	S. E.	4	E.	3	29.810	29.728	29.718	29.752	.510	.726	.619	97	76	92	15
S. E.	3	–	–	S. E.	1	29.713	–	29.767	–	.657	–	.642	100	–	100	16
S. E.	1	S. E.	2	S.	2	29.872	29.836	29.832	29.847	.713	.780	.678	100	97	100	17
S. E.	2	S. W.	4	–	–	29.734	29.682	29.702	29.706	.662	.778	.581	100	98	97	18
N.W.	2	N.W.	2	W.	1	29.784	29.810	29.846	29.813	.416	.413	.514	82	51	98	19
W.	1	W.	1	W.	1	29.907	29.897	29.949	29.915	.484	.530	.507	97	59	86	20
S. W.	1	S. E.	2	S. E.	3	29.980	29.902	29.929	29.937	.552	.681	.595	96	74	93	21
S. E.	1	S. E.	3	S. E.	1	29.940	29.891	29.912	29.917	.505	.580	.472	91	63	83	23
S. E.	2	S. E.	2	S. E.	2	29.894	29.801	29.762	29.819	.469	.609	.674	85	67	98	23
S. E.	1	S. W.	1	S. E.	3	29.721	29.644	29.673	29.679	.631	.819	.571	100	76	82	24
E.	2	E.	4	N. E.	4	29.721	29.759	29.841	29.774	.533	.543	.487	94	83	94	25
N. E.	1	N. E.	3	N. E.	2	29.889	29.851	29.883	29.874	.439	.443	.405	88	56	74	26
N.W.	4	N.W.	1	N.W.	1	29.786	29.693	29.672	29.717	.500	.603	.600	100	100	100	27
S. W.	1	W.	2	E.	2	29.645	29.655	29.737	29.679	.687	.704	.592	100	67	92	28
N.W.	3	S. W.	2	S. E.	3	29.938	29.773	29.726	29.812	.507	.478	.513	86	50	76	29
S. E.	2	S. W.	4	S. W.	2	29.642	29.455	29.375	29.491	.563	.735	.718	94	65	81	30

Per cent. of Time and Force: N. W. & W. 21; S. W. & S. 16; S. E. & E. 48; N. E. & N. 15.

Barometer: Mean, ... 29.756; Max. . . . . 30.016; Min. 29.306

Force or Pressure of Vapor: Mean, . .534; Max. . .820; Min. . . .309

Relative Humidity: Mean, . .82; Max. . . .100; Min. . . .40

JULY, 1867.

Day of Month.	Thermometer in the open air. 7 A. M.	2 P. M.	9 P. M.	Mean.	Rain and Snow. Time of begin'g of rain or snow.	Time of ending of rain or snow.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Clouds. 7 A. M. Amount of cloudiness.	Kind of clouds.	2 P. M. Amount of cloudiness.	Kind of clouds.	9 P. M. Amount of cloudiness.	Kind of clouds.
1	77.0	79.5	66.0	74.2	-	-	-	-	2	Cum. & Str.	-	Cum. .	1	Str. .
2	63.5	79.0	66.3	69.6	-	-	-	-	-	-	3	Cum. .	-	-
3	67.8	85.8	74.0	75.9	-	-	-	-	-	-	2	Cir. .	-	-
4	72.0	73.0	68.3	71.1	1½ P. M.	10 P. M.	0.698	-	6	Str. .	9	Nim. .	10	Nim. .
5	63.7	64.0	61.5	63.1	6 A. M.	-	-	-	10	Nim. .	10	Nim. .	10	Nim. .
6	61.0	71.8	73.8	68.9	-	9 A. M.	0.678	-	10	Nim. .	9	Str. .	10	Str. .
7	72.8	84.0	72.0	76.3	*	Night.	0.051	-	1	Cum. .	1	Cir. .	5	Str. .
8	66.0	79.0	65.5	70.2	-	-	-	-	8	Str. & Cir. .	7	Str. .	7	Str. .
9	63.0	75.0	61.0	66.3	9 P. M.	Night.	1.223	-	4	Str. .	5	Cum. .	10	Nim. .
10	61.2	76.1	62.5	66.6	-	-	-	-	2	Str. .	7	Cir. & Cum. .	2	Cir. .
11	65.5	79.8	69.0	68.1	-	-	-	-	7	Str. .	1	Cir. .	1	Str. .
12	69.0	80.0	71.0	70.0	* †	Night.	0.187	-	10	Str. .	9	Str. .	9	Str. .
13	58.0	69.9	61.0	63.0	-	-	-	-	10	Str. .	-	-	7	Str. .
14	58.0	77.0	62.5	65.8	-	-	-	-	-	Str. .	2	Cum. .	-	-
15	58.0	78.9	64.5	67.1	-	-	-	-	1	Fog, .	1	Cum. .	2	Cir. .
16	63.0	73.0	62.5	66.2	-	-	-	-	2	Cir. .	9	Str. .	1	Str. .
17	60.0	75.0	57.3	64.1	-	-	-	-	1	Fog, .	3	Cum. .	-	-
18	57.0	66.9	58.7	60.9	-	-	-	-	7	Str. .	8	Str. .	8	Str. .
19	57.9	62.0	61.0	60.3	1½ P. M.	-	0.470	-	8	Str. .	9	Nim. .	9	Nim. .
20	57.9	65.0	61.0	61.3	*	Noon.	0.111	-	10	Nim. .	10	Str. .	10	Nim. .
21	57.0	64.2	61.7	61.0	†	-	-	-	8	Str. .	10	Nim. .	5	Str. .
22	60.8	71.0	63.0	64.9	-	-			7	Str. .	7	Str. .	1	Str. .
23	60.0	80.9	69.8	70.2	-	-	-	-		-	-	-	1	Str. .
24	64.0	85.6	76.0	75.2	-	-	-	-		-	-	Smoke.	2	Str. .
25	70.4	80.1	69.0	73.2	4 P. M.	Night.	0.192	-	6	Str. .	9	Nim. .	10	Nim. .
26	68.3	72.3	67.0	69.2	*	A. M.	0.390	-	10	Str. .	9	Str. .	9	Str. .
27	66.0	73.7	68.0	69.2	-	-	-	-	9	Str. .	9	Str. .	10	Str. .
28	69.0	83.0	77.0	76.3	†	P. M.	-	-	10	Str. .	7	Str. .	2	Str. .
29	74.9	81.8	68.6	75.1	-	-	-	-	8	Str. .	8	Str. .	-	-
30	61.0	75.3	61.0	65.8	-	-	-	-	-	-	4	Cu-str.	-	Str. .
31	55.0	74.0	61.0	63.3	-	-	-	-	1	Str. .	7	Cu-str.	3	Str. .
	Mean, . . 68.14 Max. . . 90.0 Min. . . 55.0				Sum, . . . 4.000			-	Mean, ... 5.2					

* Shower. † Sprinkle.

JULY, 1867.—Continued.

Winds. 7 A. M. Direction.	Force.	2 P. M. Direction.	Force.	9 P. M. Direction.	Force.	Barometer height reduced to freezing point. 7 A. M.	2 P. M.	9 P. M.	Mean.	Force or Pressure of Vapor. In Inches. 7 A. M.	2 P. M.	9 P. M.	Relative Humidity or Fraction of Saturation. 7 A. M.	2 P. M.	9 P. M.	Day of Month.
W.	3	N.W.	4	N.W.	1	29.400	29.518	29.618	29.512	.672	.443	.410	75	46	66	1
W.	1	W.	1	N.W.	1	29.689	29.628	29.620	29.646	.510	.457	.542	88	49	88	2
S. W.	1	S. W.	3	W.	1	29.644	29.587	29.573	29.601	.622	.578	.775	93	48	95	3
E.	1	S. W.	1	W.	1	29.525	29.507	29.568	29.533	.712	.700	.685	92	92	100	4
E.	2	N. E.	1	N. E.	1	29.684	29.728	29.728	29.713	.580	.553	.543	100	94	100	5
N.	1	S. E.	1	S. E.	1	29.667	29.539	29.454	29.553	.533	.717	.817	100	95	100	6
N.W.	4	N.W.	2	S. E.	1	29.518	29.521	29.587	29.542	.624	.614	.681	79	54	90	7
N.W.	1	W.	3	W.	1	29.682	29.684	29.712	29.693	.484	.460	.511	78	49	83	8
N.	2	S. E.	2	S.	1	29.745	29.640	29.648	29.678	.488	.539	.508	86	65	95	9
N.W.	3	N.W.	2	N.	1	29.749	29.766	29.794	29.770	.473	.434	.508	88	50	91	10
E.	2	S. W.	3	S. E.	3	29.768	29.659	29.634	29.687	.593	.678	.664	94	68	95	11
S. E.	2	S. W.	2	N.W.	2	29.566	29.550	29.612	29.576	.701	.704	.579	100	69	78	12
N.	4	N.	3	N.W.	1	29.753	29.821	29.912	29.829	.348	.351	.450	72	49	87	13
N.W.	1	E.	1	–	–	30.025	29.988	29.988	30.000	.435	.469	.495	92	52	90	14
S. E.	1	S. W.	2	S. E.	1	29.974	29.863	29.801	29.879	.475	.494	.526	100	52	89	15
S. E.	2	S. W.	2	S.	2	29.753	29.680	29.705	29.713	.516	.628	.558	91	80	100	16
W.	1	N.	2	N.W.	1	29.771	29.737	29.789	29.766	.518	.422	.447	100	50	99	17
N.	1	N.	2	N.W.	1	29.803	29.774	29.790	29.789	.455	.428	.439	99	67	89	18
N.	2	N.	1	N.	2	29.796	29.703	29.701	29.733	.455	.528	.502	97	97	94	19
N.	1	N. E.	3	N.	1	29.651	29.595	29.528	29.591	.493	.509	.518	100	83	100	20
N.W.	3	N. E.	2	N.W.	1	29.418	29.428	29.429	29.425	.427	.467	.496	92	79	92	21
N. E.	1	N.W.	3	N.W.	1	29.441	29.413	29.500	29.451	.495	.523	.514	94	69	90	22
N.W.	1	E.	1	E.	1	29.592	29.617	29.647	29.619	.518	.570	.592	100	57	84	23
N.W.	1	S. W.	2	S.	1	29.667	29.572	29.521	29.587	.596	.847	.785	100	72	90	24
S. E.	1	S. W.	1	S. W.	1	29.532	29.455	29.522	29.500	.701	.916	.708	98	91	100	25
N.W.	1	W.	2	N.W.	1	29.397	29.501	29.627	29.508	.685	.668	.622	100	86	95	26
S. E.	1	S. E.	2	S. E.	2	29.735	29.755	29.723	29.738	.631	.713	.663	100	89	98	27
S. E.	2	S.	4	S. E.	2	29.659	29.577	29.494	29.577	.708	.977	.868	100	87	97	28
S. W.	1	S. W.	1	N.W.	2	29.504	29.466	29.598	29.523	.790	.916	.505	94	87	73	29
N.W.	1	W.	3	W.	1	29.756	29.763	29.855	29.791	.396	.434	.486	75	51	94	30
N.W.	2	E.	2	S. E.	3	29.995	29.947	29.947	29.963	.433	.489	.505	100	63	97	31

Per cent. of Time and Force: N. W. & W. 38; S. W. & S. 18; S. E. & E. 24; N. E. & N. 20.

Mean, ... 29.661
Max. 30.025
Min. 29.397

Mean, . . .572
Max. . . .977
Min. . . .348

Mean, . . 85
Max. . . 100
Min. . . 46

AUGUST, 1867.

Day of Month.	Thermometer in the open air. 7 A. M.	2 P. M.	9 P. M.	Mean.	Rain and snow. Time of begin'g of rain or snow.	Time of ending of rain or snow.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Clouds. 7 A. M. Amount of cloudiness.	Kind of clouds.	2 P. M. Amount of cloudiness.	Kind of clouds	9 P. M. Amount of cloudiness.	Kind of clouds.
1	56.0	72.0	66.0	64.7	Night.	–	–	–	2	Cir. .	7	Cu-str.	10	Str. .
2	63.8	68.8	68.0	66.9	–	5 P. M.	2.025	–	10	Nim. .	10	Nim. .	2	Str. .
3	67.0	68.0	64.0	66.3	5 A. M.	5 P. M.	0.548	–	10	Nim. .	10	Nim. .	–	–
4	61.4	78.0	66.0	68.5	–	–	–	–	9	Fog, .	2	Cum. .	2	Cir. .
5	61.0	80.8	67.0	69.6	–	–	–	–	1	Cir. .	–	Cir. .	1	Cir. .
6	63.5	79.7	71.0	71.4	–	–	–	–	10	Str. .	8	Cu-str.	8	Str. .
7	70.7	83.5	72.0	75.4	*	3 P. M.	0.135	–	9	Fog, Str.	7	Cum. .	3	Str. .
8	71.7	82.0	69.8	74.5	–	–	–	–	7	Str. .	4	Cum. .	–	–
9	69.0	80.4	71.2	73.5	–	–	–	–	10	Str. .	2	Cir & Cum.	5	Str. .
10	72.0	69.2	67.0	69.4	*	2 P. M.	0.360	–	1	Str. .	9	Nim. .	8	Str. .
11	62.0	76.1	62.3	66.8	–	–	–	–	1	Str. .	1	Cum. .	–	–
12	55.5	76.1	77.0	66.2	–	–	–	–	–	–	–	–	1	Str. .
13	64.5	73.8	68.8	69.0	Night.	–	–	–	3	Str .	9	Str. .	9	Str. .
14	70.0	83.3	69.0	74.1	–	10 P. M.	1.444	–	10	Nim. .	7	Cum. .	10	Nim. .
15	69.0	70.0	66.2	68.4	8 A. M.	–	–	–	9	Str. .	10	Nim. .	10	Nim. .
16	66.9	68.8	68.8	68.0	–	7 P. M.	3.324	–	10	Nim. .	10	Nim. .	10	Nim. .
17	69.5	71.8	69.0	70.1	†	–	0.178	–	8	Str. .	9	Nim. .	5	–
18	67.8	83.0	72.3	74.4	†	Even'g.	–	–	2	Str. .	–	–	3	Cum. .
19	69.7	82.9	68.0	73.5	†	5 A. M.	–	–	7	Str. .	5	Cir. & Cum.	–	Str. .
20	63.3	73.4	62.7	66.5	–	–	–	–	3	Str. .	9	Str. .	–	Str. .
21	59.9	79.0	66.8	68.6	–	–	–	–	8	Str. .	5	Cum. .	2	Str. .
22	63.0	69.0	64.2	65.4	$1\frac{1}{2}$ P. M.	–	–	–	10	Cu-str.	10	Nim. .	10	Nim. .
23	62.0	65.5	64.0	63.8	–	6 P. M.	0.730	–	10	Nim. .	10	Nim. .	8	Str. .
24	63.0	77.5	66.0	68.8	*5 P. M.	7 P. M.	0.185	–	10	Str. .	1	Cum. .	9	Str. .
25	60.9	73.8	60.0	64.9	–	–	–	–	–	–	–	–	–	–
26	57.3	77.0	64.5	66.3	–	–	–	–	–	–	–	Cum. .	2	Str. .
27	59.8	76.0	64.0	66.6	–	–	–	–	7	Fog, .	–	Str. .	5	Str. .
28	64.4	79.3	71.3	71.7	–	–	–	–	10	Str. .	5	Cu-str.	10	Str. .
29	71.3	71.8	64.8	69.3	7 A. M.	11 A. M.	0.232	–	10	Nim. .	8	Str. .	3	Str. .
30	58.2	67.4	55.0	66.2	–	–	–	–	4	Str. .	2	Cu-str.	–	–
31	48.3	66.0	55.0	56.4	–	–	–	–	–	–	1	Str. .	1	Str. .
	Mean, . . 68.56 Max. . . 83.5 Min. . . 48.3				Sum, . . . 9,161			–	Mean, ... 5.3					

* Thunder Shower. † Sprinkle.

AUGUST, 1867.—Continued.

Winds. 7 A. M. Direction.	Force.	Winds. 2 P. M. Direction.	Force.	Winds. 9 P. M. Direction.	Force.	Barometer Height Reduced to Freezing Point. 7 A. M.	2 P. M.	9 P. M.	Mean.	Force or Pressure of Vapor, In Inches. 7 A. M.	2 P. M.	9 P. M.	Relative Humidity or Fraction of Saturation. 7 A. M.	2 P. M.	9 P. M.	Day of Month.
S. E.	1	S. E.	2	S. E.	1	29.909	29.808	29.752	29.823	.449	.423	.593	100	77	94	1
N. E.	1	N.	1	–	–	29.657	29.531	29.464	29.551	.584	.693	.647	100	100	95	2
S. E.	1	S. E.	1	–	–	29.669	29.717	29.782	29.723	.650	.673	.590	100	100	100	3
N.W.	1	N.W.	2	N.W.	1	29.899	29.870	29.883	29.884	.537	.639	.573	100	69	93	4
S.W.	1	W.	1	W.	1	29.917	29.869	29.886	29.891	.537	.495	.622	100	49	96	5
S. E.	1	S. W.	3	S. E.	1	29.924	29.895	29.897	29.905	.578	.813	.738	100	82	100	6
S. E.	2	S. E.	1	S. E.	1	29.915	29.845	29.849	29.870	.742	.847	.770	100	75	98	7
W.	1	S. W.	2	S. E.	1	29.983	29.836	29.835	29.851	.769	.808	.708	100	76	100	8
S. E.	1	S. E.	2	S. E.	2	29.856	29.796	29.894	29.819	.686	.757	.714	99	76	97	9
S. E.	3	W.	2	S. E.	2	29.754	29.682	29.762	29.733	.772	.703	.657	100	100	100	10
N.W.	1	N.W.	3	S. E.	1	29.851	29.827	29.839	29.839	.527	.446	.504	96	50	94	11
W.	1	S. W.	1	S. E.	3	29.849	29.753	29.680	29.761	.435	.547	.563	100	62	88	12
S. E.	4	S.	3	S.	4	29.630	29.550	29.573	29.584	.584	.683	.620	97	84	89	13
S. E.	1	S.	2	S.	2	29.597	29.617	29.713	29.642	.720	.871	.696	100	79	100	14
N. E.	1	N.	1	N.	1	29.766	29.803	29.802	29.791	.703	.728	.635	100	100	100	15
N. E.	2	N. E.	1	W.	1	29.708	29.540	29.491	29.580	.647	.662	.708	100	100	100	16
E.	2	S. E.	1	E.	1	29.485	29.386	29.443	29.438	.713	.780	.708	100	100	100	17
S. E.	3	S. W.	3	W.	1	29.563	29.544	29.573	29.560	.673	.943	.630	100	85	82	18
S. E.	1	S. W.	4	N.W.	1	29.594	29.593	29.632	29.606	.626	.731	.667	88	67	96	19
S.W.	1	S. W.	2	N.	1	29.726	29.710	29.710	29.715	.543	.584	.552	94	73	98	20
N.W.	1	N.W.	1	N.W.	1	29.729	29.662	29.660	29.684	.507	.628	.625	100	65	98	21
N.W.	1	N.W.	2	N. E.	2	29.694	29.692	29.693	29.693	.568	.649	.538	100	94	93	22
N. E.	2	N. E.	2	–	–	29.631	29.562	29.569	29.587	.554	.618	.590	100	100	100	23
S. E.	1	S. E.	2	N.W.	1	20.581	29.506	29.580	29.556	.570	.804	.624	100	88	100	24
S. E.	1	N.	3	S.	1	29.716	29.743	29.826	29.762	.524	.480	.490	100	59	96	25
S. E.	1	S. E.	2	S. E.	2	29.907	29.839	29.856	29.867	.466	.652	.566	100	73	94	26
S. E.	1	S.	3	S. E.	1	29.849	29.756	29.738	39.781	.509	.610	.576	100	70	100	27
S. E.	1	S. E.	5	S. E.	3	29.673	29.543	29.522	29.579	.596	.768	.736	100	79	97	28
S. E.	1	N.W.	2	W.	1	29.474	29.479	29.533	29.495	.759	.547	.501	100	72	83	29
W.	1	N.W.	4	N.W.	2	29.619	29.681	29.868	29.723	.483	.357	.293	100	54	68	30
N.	1	S. W.	3	S. E.	2	29.969	29.894	29.8I0	29.891	.334	.366	.406	100	58	94	31

Per cent. of Time & Force: N. W. & W. 22; S. W. & S. 23; S. E. & E. 42; N. E. & N. 13.	Mean, ... 29.716 Max. . . . . 29.983 Min. 29.386	Mean, . . .618 Max. . . .943 Min. . . .293	Mean, . . 91 Max. . . 100 Nim. . . 49

SEPTEMBER, 1867.

Day of Month.	Thermometer in the open air. 7 A. M.	2 P. M.	9 P. M.	Mean.	Rain and snow. Time of begin'g of rain or snow.	Time of ending of rain or snow.	Amount of rain or melted snow in gauge, inches.	Depth of snow, inches.	Clouds. 7 A. M. Amount of cloudiness.	Kind of clouds.	2 P. M. Amount of cloudiness.	Kind of clouds.	9 P. M. Amount of cloudiness.	Kind of clouds.
1	50.0	69.0	59.0	59.3	–	–	–	–	2	Str. .	8	Str. .	3	Str. .
2	57.0	71.3	65.0	64.4	–	–	–	–	5	Str. .	8	Str. .	8	Str. .
3	63.0	75.1	62.0	66.7	5 A. M.*	–	–	–	10	Nim. .	8	Str. .	1	Str. .
4	63.4	77.7	63.8	68.3	7½ A.M.†	–	0.096	–	10	Str. .	5	Cu-str.	1	Str. .
5	59.4	77.2	65.1	67.2	7 P. M.‡	–	0.313	–	7	Cu-str.	8	Cu-str.	9	Str. .
6	64.7	72.5	68.0	68.4	–	–	–	–	10	Str. .	9	Str. .	10	Str. .
7	67.0	67.0	62.3	65.4	–	–	–	–	10	Str. .	8	Str. .	9	Str. .
8	59.0	70.5	58.7	62.7	–	–	–	–	9	Str. .	3	Cir. & Str. .	1	Cir. .
9	55.7	67.4	63.6	62.2	–	–	–	–	9	Str. .	10	Str. .	10	Str. .
10	64.0	66.1	59.7	63.3	Noon.*	–	–	–	10	Str. .	8	Nim. .	9	Str. .
11	48.5	66.9	49.0	53.8	–	–	–	–	–	–	1	Cum. .	–	–
12	45.0	68.7	56.9	56.9	–	–	–	–	–	Str. .	1	Str. .	1	Str. .
13	57.5	76.0	68.0	67.2	9½ P.M.§	–	0.112	–	10	Str. .	2	Cir. .	9	Str. .
14	50.4	60.5	49.7	53.5	–	–	–	–	–	–	–	Cir. .	–	–
15	41.0	59.9	49.5	50.1	–	–	–	–	7	Str. .	2	Cir. .	–	–
16	47.8	65.0	62.5	58.4	–	–	–	–	8	Str. .	9	Str. .	5	Str. .
17	59.4	80.0	65.5	68.3	–	–	–	–	2	Str. .	8	Str. .	10	Str. .
18	62.6	74.5	69.0	68.7	9½ P.M.‡	–	0.098	–	10	Str. .	3	Str. .	10	Nim. .
19	69.1	68.0	58.5	65.2	–	–	–	–	9	Str. .	10	Str. .	–	–
20	61.0	74.5	69.0	68.2	–	–	–	–	10	Str. .	4	Str. .	10	Str. .
21	–	67.2	57.0	–	–	–	–	–	9	Str. .	6	Str. .	8	Str. .
22	46.8	65.8	56.0	56.2	–	–	–	–	7	Fog, .	4	Str. .	–	–
23	45.8	57.7	43.7	49.1	–	–	–	–	–	–	–	–	–	–
24	44.5	62.9	53.7	53.7	–	–	–	–	–	Fog in valleys.	–	–	–	–
25	52.0	62.1	57.2	57.1	3 P. M.	–	0.190	–	5	Cir. .	10	Nim. .	7	Str. .
26	50.9	58.0	48.2	52.4	–	–	–	–	5	Str. .	2	Cu-str.	–	–
27	39.5	65.0	50.6	51.7	–	–	–	–	–	–	–	–	–	–
28	39.0	68.5	56.0	54.5	–	–	–	–	6	Fog, .	–	–	–	–
29	55.2	72.3	62.0	63.2	Night.	–	–	–	10	Fog, .	–	–	5	Str. .
30	41.9	48.7	39.8	43.5	–	10 A. M.	0.298	–	10	Nim. .	3	Str. .	1	Str. .
	Mean, . . 59.99 Max. . . 80.0 Min. . . 39.0				Sum, . . . 1.107			–	Mean, ... 5.1					

* Sprinkle. † Little shower. ‡ Thunder-shower. § Shower.

SEPTEMBER, 1867.—Continued.

WINDS.						BAROMETER.				FORCE OR PRESSURE OF VAPOR, IN INCHES.			RELATIVE HUMIDITY OR FRACTION OF SATURATION.			Day of Month.
7 A. M.		2 P. M.		9 P. M.		BAROMETER HEIGHT REDUCED TO FREEZING POINT.										
Direction.	Force.	Direction.	Force.	Direction.	Force.	7 A. M.	2 P. M.	9 P. M.	Mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	
N.W.	2	E.	1	W.	1	29.651	29.512	29.535	29.566	.361	.588	.489	100	85	100	1
S.W.	1	S. W.	1	E.	1	29.775	29.809	29.854	29.813	.463	.543	.592	100	73	97	2
E.	1	S. E.	1	E.	2	29.895	29.845	29.840	29.860	.572	.643	.548	100	79	100	3
S. E.	2	S. W.	3	W.	1	29.802	29.730	29.762	29.765	.576	.770	.580	100	83	100	4
W.	2	S. E.	1	S. E.	1	29.821	29.774	29.771	29.789	.494	.782	.605	99	86	100	5
S. E.	3	S. E.	3	S. E.	2	29.769	29.732	29.742	29.748	.603	.709	.677	100	91	99	6
N.	3	N.	4	E.	1	29.803	29.912	30.007	29.907	.662	.391	.519	100	61	94	7
N.	3	N. E.	3	N. E.	1	30.106	30.062	30.036	30.068	.352	.479	.449	70	66	92	8
N.W.	2	S. E.	2	S. W.	1	29.954	29.824	29.748	29.842	.443	.606	.576	100	92	100	9
S. E.	1	N.	2	N.W.	4	29.602	29.590	29.701	29.631	.588	.212	.377	100	81	75	10
N.	1	N.	1	–	–	29.861	29.840	29.834	29.845	.311	.371	.341	91	64	100	11
N.W.	1	S. W.	4	S. E.	2	29.822	29.723	29.705	29.750	.298	.478	.443	100	72	97	12
S. E.	2	S. W.	4	W.	1	29.665	29.484	29.516	[illegible].555	.473	.688	.680	100	78	99	13
N. E.	4	N.	4	N.W.	2	29.822	29.908	30.045	29.925	.235	.226	.266	65	43	78	14
N.W.	1	S. W.	3	E.	1	30.179	30.137	30.105	30.140	.257	.380	.335	100	76	94	15
S. E.	1	S. W.	2	S.	2	30.089	29.975	29.913	29.992	.331	.516	.639	100	85	97	16
N.W.	1	S. E.	1	S. E.	2	29.925	29.906	30.009	29.947	.504	.804	.574	100	81	93	17
S. E.	1	S. E.	2	–	–	29.993	29.845	29.787	29.875	.560	.772	.708	100	91	100	18
N.W.	1	N. E.	2	S. E.	1	29.800	29.862	29.900	29.854	.706	.571	.309	100	85	64	19
S. E.	2	S. E.	3	S. E.	2	29.877	29.735	29.697	29.770	.524	.702	.708	99	83	100	20
N.	2	N.	2	N.	1	–	29.825	29.861	–	–	.396	.449	–	60	100	21
S. E.	1	W.	3	W.	1	29.846	29.740	29.717	29.768	.311	.414	.405	100	67	94	22
N.W.	5	N.W.	3	N.W.	1	29.955	30.040	30.151	30.049	.202	.229	.216	67	49	77	23
N.W.	2	S. W.	4	S. E.	2	30.216	30.093	30.002	30.104	.278	.340	.375	100	61	93	24
S. E.	3	N.W.	2	N.W.	2	29.752	29.581	29.664	29.666	.377	.530	.399	98	97	86	25
N.W.	3	N.W.	4	N.W.	3	29.729	29.698	29.731	29.719	.311	.279	.267	84	58	81	26
N. E.	2	N.W.	1	N. E.	1	29.764	29.702	29.720	29.729	.238	.332	.338	100	55	94	27
N.W.	1	S. E.	2	S. E.	2	29.748	29.660	29.672	29.693	.238	.488	.431	100	75	99	28
S. E.	2	S. E.	3	S. E.	1	29.551	29.403	29.379	29.444	.433	.562	.529	100	71	97	29
N.W.	4	N.W.	6	N.W.	3	29.524	29.564	29.682	29.590	.249	.172	.173	96	52	73	30
Per cent. of Time and Force: N. W. & W. 34; S. W. & S. 14; S. E. & E. 32; N. E. & N. 20.						Mean, ... 29.807 Max. . . . . 30.216 Min. 29.379				Mean, . . .460 Max. . . .782 Min. . . .171			Mean, . . 86 Max. . . 100 Min. . . 43			

OCTOBER, 1867.

Day of Month.	THERMOMETER IN THE OPEN AIR.				RAIN AND SNOW.				CLOUDS.					
									7 A. M.		2 P. M.		9 P. M.	
	7 A. M.	2 P. M.	9 P. M.	Mean.	Time of begin'g of rain or snow.	Time of ending of rain or snow.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Amount of cloudiness.	Kind of clouds.	Amount of cloudiness.	Kind of clouds.	Amount of cloudiness.	Kind of clouds.
1	39.0	58.5	45.0	47.5	–	–	–	–	–	–	–	–	1	Str.
2	44.5	68.8	60.5	57.9	–	–	–	–	–	–	6	Str.	8	Str.
3	57.0	61.0	51.5	56.5	–	–	–	–	2	Cu-str.	6	Str.	8	Str.
4	34.9	55.0	49.7	43.2	Night.	–	–	–	3	Str.	7	Str.	10	Str.
5	48.2	51.0	52.5	50.6	–	10 P. M.	1.852	–	10	Nim.	10	Nim.	10	Nim.
6	45.0	53.0	46.0	48.0	–	–	–	–	1	Str.	3	Cu-str.	5	Str.
7	37.7	52.0	38.8	42.8	–	–	–	–	–	–	–	–	–	–
8	32.4	58.3	42.6	44.4	–	–	–	–	–	–	–	Str.	8	Str.
9	39.0	59.0	55.0	51.0	–	–	–	–	5	Str.	9	Str.	10	Str.
10	52.0	67.7	54.3	58.0	–	–	–	–	7	Str.	7	Str.	1	Cir.
11	55.0	55.0	51.2	53.7	2 P. M.	–	–	–	10	Str.	10	Nim.	10	Nim.
12	45.5	49.2	48.8	47.8	–	3 P. M.	0.470	–	10	Nim.	10	Nim.	10	Str.
13	45.0	54.8	47.0	48.9	–	–	–	–	8	Str.	3	Cu-str.	9	Str.
14	34.4	60.0	45.3	46.6	–	–	–	–	3	Fog,	1	Cum.	3	Cir.
15	35.8	60.3	46.9	47.5	–	–	–	–	3	Cir.	6	Str.	–	–
16	38.0	60.8	46.0	48.3	–	–	–	–	1	Fog,	–	–	1	Str.
17	43.0	67.8	54.5	55.1	–	–	–	–	–	Fog,	1	Cir.	–	–
18	52.9	76.0	61.3	63.4	–	–	–	–	–	Smoke,	1	Cum.	–	–
19	52.0	73.8	56.0	60.6	–	–	–	–	–	Smoke,	2	Cir.	1	Str.
20	46.5	70.7	55.0	57.4	–	–	–	–	2	Str.	3	Cir.	–	–
21	51.7	56.0	53.9	51.9	Night.	–	0.049	–	10	Str.	10	Str.	10	Nim.
22	56.0	67.0	52.7	58.9	6 P. M.	Night.	0.357	–	10	Nim.	5	Str.	10	Nim.
23	41.8	50.0	37.8	43.2	–	–	–	–	5	Str.	–	Str.	–	–
24	28.0	50.0	36.0	38.0	–	–	–	–	–	–	–	–	–	–
25	27.0	54.0	45.5	42.2	–	–	–	–	1	Str.	–	Cum.	2	Str.
26	32.0	58.2	41.5	43.9	–	–	–	–	–	–	2	Cum.	–	–
27	30.0	60.0	40.0	43.3	–	–	–	–	–	–	–	–	–	–
28	31.1	57.2	49.7	46.0	–	–	–	–	3	Str.	3	Str.	–	Smoke,
29	47.0	51.3	49.7	49.3	6 A. M.	Night.	1.117	–	10	Nim.	10	Nim.	10	Nim.
30	46.0	51.8	51.0	49.6	Mist.	–	–	–	10	Str.	10	Nim.	7	Str.
31	46.3	58.3	49.7	51.4	–	–	–	–	2	Str.	9	Str.	–	–
	Mean, . . 49.90 Max. . . 76.0 Min. . . 27.0				Sum, . . . 3.845			–	Mean, ... 4.1					

OCTOBER, 1867.—Continued.

WINDS.						BAROMETER.				FORCE OR PRESSURE OF VAPOR, IN INCHES.			RELATIVE HUMIDITY OR FRACTION OF SATURATION.			Day of Month.
7 A. M.		2 P. M		9 P. M.		BAROMETER HEIGHT REDUCED TO FREEZING POINT.										
Direction.	Force.	Direction.	Force.	Direction.	Force.	7 A. M.	2 P. M.	9 P. M.	Mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	
N.W.	2	N.W.	4	N.W.	1	29.694	29.594	29.540	29.509	.208	.177	.256	91	37	90	1
S. E.	3	S. W.	3	E.	1	29.517	29.376	29.319	29.404	.265	.380	.420	92	56	81	2
W.	4	W.	4	W.	1	29.431	29.521	29.707	29.553	.325	.286	.187	70	54	50	3
N.W.	3	S. E.	3	S. E.	4	29.905	29.936	29.964	29.934	.193	.278	.206	97	66	86	4
E.	1	N.	2	N.	2	29.823	29.490	29.465	29.593	.330	374	.388	98	100	100	5
N.W.	3	N.W.	5	N.W.	2	29.649	29.761	29.915	29.775	.234	.226	.228	78	59	76	6
W.	2	N.W.	4	N.W.	1	30.005	30.002	30.092	30.033	.199	.175	.189	90	46	83	7
S. E.	1	S. W.	1	S. E.	1	30.126	30.013	29.981	30.040	.179	.263	.267	99	58	100	8
S. E.	2	S.	3	S.	2	29.886	29.731	29.567	29.728	.238	.309	.389	100	64	93	9
S. E.	1	S. W.	3	E.	1	29.421	29.341	29.354	29.372	.382	.359	.403	100	54	100	10
N. E.	1	N. E.	2	N. E.	2	29.428	29.478	29.468	29.458	.424	.396	.344	98	92	93	11
N. E.	1	N. E.	2	S. E.	2	29.475	29.508	29.497	29.493	.302	.297	.330	100	86	98	12
N.W.	2	N.W.	4	E.	1	29.590	29.594	29.654	29.613	.265	.223	.283	92	53	90	13
N.W.	2	W.	3	N.	1	29.704	29.641	29.707	29.684	.194	.251	.275	100	49	92	14
W.	1	S. W.	1	W.	1	29.726	29.593	29.717	29.679	.204	.401	.275	100	76	89	15
N.W.	1	W.	1	W.	1	29.889	29.899	29.947	29.912	.227	.296	.295	100	57	98	16
S. W.	1	S. W.	3	S. E.	2	29.936	29.755	29.700	29.797	.275	.466	.426	100	70	100	17
S. E.	3	W.	4	N.W.	1	29.615	29.548	29.614	29.592	.395	.449	.378	100	52	71	18
E.	1	S. W.	1	N.W.	1	29.733	29.740	29.836	29.770	.388	.469	.365	100	57	85	19
S. E.	2	N. E.	3	N. E.	1	29.985	30.005	30.087	30.026	.312	.416	.364	100	57	85	20
S. E.	1	S. E.	1	S. E.	1	30.065	29 997	29.977	29.946	.374	.411	.410	100	94	100	21
S. E.	2	S. W.	3	W.	2	29.852	29.695	29.768	29.772	.446	.567	.364	100	88	93	22
N.W.	3	N.W.	3	N.W.	1	29.775	29.987	30.137	29.966	.203	.167	.172	80	48	78	23
N.W.	1	N.W.	3	N.W.	2	30.224	30.184	30.206	30.205	.147	.147	.193	100	41	84	24
S. E.	2	S. E.	2	S. E.	1	30.233	30.139	30.125	30.166	.143	.236	.211	100	58	72	25
N.W.	1	N.W.	1	N.	1	30.098	30.001	30.015	30.038	.174	.235	.222	100	50	87	26
S. E.	1	W.	2	W.	1	30.073	30.027	30.088	30.063	.165	.262	.227	100	51	95	27
S. E.	1	S. W.	1	E.	1	30.144	30.037	30.020	30.067	.172	.297	.252	100	64	71	28
N.	2	N. E.	2	N. E.	5	29.874	29.660	29.477	29.670	.280	.372	.334	88	99	94	29
N.	4	N.	4	N.W.	1	29.391	29.355	29.393	29.380	.295	.341	.354	96	89	96	30
S. W.	1	N.	3	N.W.	3	29.401	29.375	29.563	29.446	.309	.309	.231	100	64	66	31

Per cent. of Time & Force: N. W. & W. 44; S. W. & S. 12; S. E. & E. 23; N. E. & N. 21.

Barometer: Mean, ... 29.780; Max. . . . . 30.233; Min. 29.319

Vapor: Mean, . . .293; Max. . . .567; Min. . . .143

Humidity: Mean, . . 82; Max. . . 100; Min. . . 37

NOVEMBER, 1867.

Day of Month.	THERMOMETER IN THE OPEN AIR.				RAIN AND SNOW.				CLOUDS.					
									7 A. M.		2 P. M.		9 P. M.	
	7 A. M.	2 P. M.	9 P. M.	Mean.	Time of begin'g of rain or snow	Time of ending of rain or snow.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Amount of cloudiness.	Kind of clouds.	Amount of cloudiness.	Kind of clouds.	Amount of cloudiness.	Kind of clouds.
1	39.5	52.0	43.7	45.1	–	–	–	–	1	Cir.	5	Cir.	8	Str.
2	41.0	65.0	51.3	52.4	–	–	–	–	1	Str.	–	Smoke,	–	–
3	39.2	51.5	47.5	46.1	7½ P. M.	–	–	–	8	Str.	5	Str.	10	Nim.
4	56.0	44.8	41.0	47.3	–	2 P. M.	0.092	–	8	Nim.	10	Nim.	5	Str.
5	30.0	45.0	32.3	35.8	–	–	–	–	–	–	6	Cu-str.	5	Str.
6	33.5	40.8	30.0	34.8	–	–	–	–	6	Str.	3	Cu-str.	1	Str.
7	20.9	31.2	31.3	27.8	–	–	–	–	7	Str.	9	Str.	10	Str.
8	34.0	40.9	39.5	38.1	Night.	–	–	–	10	Str.	10	Str.	10	Str.
9	39.0	58.0	59.8	52.3	–	Night.	0.292	–	10	Nim.	3	Str.	10	Str.
10	57.7	64.7	52.0	58.1	4 P. M.	Night.	2.089	–	10	Str.	5	Str.	10	Nim.
11	45.0	54.5	41.3	46.9	–	–	–	–	5	Str.	1	Str.	–	–
12	41.4	35.3	34.5	37.1	6 A. M.	Night.	0 593	2.0	10	Nim.	10	Nim.	10	Nim.
13	28.0	31.0	27.9	29.0	–	–	–	–	5	Str.	2	Str.	–	–
14	23.0	39.8	37.5	33.4	–	–	–	–	2	Str.	9	Str.	1	Str.
15	27.9	31.3	25.5	28.2	7 A. M.*	–	–	–	10	Nim.	2	Str.	5	Haze,
16	27.3	45.5	37.0	36.6	7 A. M.†	9 A. M.	0.050	0.5	10	Str.	3	Cu-str.	9	Str.
17	25.1	33.0	30.2	29.4	‡	–	–	–	2	Str.	4	Str.	–	–
18	17.5	22.8	17.5	19.3	–	–	–	–	–	Str.	2	Str.	–	Str.
19	18.0	24.0	16.0	19.3	–	–	–	–	2	Str.	1	Str.	–	–
20	24.0	37.4	38.9	33.4	–	–	–	–	9	Str.	10	Nim.	10	Str.
21	36.7	37.0	26.0	33.2	–	–	–	–	10	Str.	–	Str.	–	–
22	26.2	33.9	36.0	32.0	–	–	–	–	10	Str.	10	Str.	10	Str.
23	38.7	46.2	43.0	42.6	–	–	–	–	10	Str.	10	Str.	10	Str.
24	39.0	44.0	41.0	41.3	§	–	–	–	10	Nim.	10	Str.	10	Nim.
25	44.6	51.0	43.8	46.5	Night.	–	–	–	10	Str.	10	Str.‖	10	Str.
26	45.0	55.3	39.8	46.7	–	Noon.	0.185	–	10	Nim.	3	Str.	5	Str.
27	33.5	46.3	34.6	38.1	–	–	–	–	–	–	1	Str.	9	Str.
28	33.0	38.0	36.8	35.9	8 A. M.	–	–	–	10	Str.	10	Nim.	10	Str.
29	38.0	43.0	46.0	42.3	–	Night.	1.005	–	10	Nim.	10	Nim.	10	Nim.
30	30.5	25.7	16.0	24.1	–	–	–	–	3	Str.	3	Cu-str.	–	–
	Mean, . . 37.87				Sums, . . . 4 305			2.5	Mean, ... 6.0					
	Max. . . 65.0													
	Min. . . 17.5													

* Flakes. † Snow. ‡ Snow in evening. § Fog and Mist. ‖ Smoky.

NOVEMBER, 1867.—Continued.

Winds. 7 A. M. Direction.	7 A. M. Force.	2 P. M. Direction.	2 P. M. Force.	9 P. M. Direction.	9 P. M. Force.	Barometer. Barometer height reduced to freezing point. 7 A. M.	2 P. M.	9 P. M.	Mean.	Force or Pressure of Vapor, in Inches. 7 A. M.	2 P. M.	9 P. M.	Relative Humidity or Fraction of Saturation. 7 A. M.	2 P. M.	9 P. M.	Day of Month.
N.W.	2	S. W.	2	S. E.	3	29.754	29.652	29.517	29.641	.173	.218	.248	73	58	90	1
S. E.	1	S. W.	2	N.W.	6	29.320	29.133	29.377	29.277	.255	.322	.173	100	54	46	2
W.	2	S. W.	2	S.	1	29.644	29.598	29.469	29.570	.175	.208	.323	73	55	100	3
S. E.	3	N.W.	2	N.W.	2	29.261	29.519	29.784	29.521	.444	.239	.175	100	82	69	4
N.W.	1	N.W.	3	N.W.	2	29.980	29.977	30.000	29.986	.162	.158	.149	98	53	84	5
N.W.	2	N.W.	4	N.W.	4	29.842	29.826	29.979	29.882	.161	.089	.099	84	36	61	6
N.W.	2	S. W.	2	S.	1	30.018	30.046	29.993	30.019	.094	.101	.172	88	60	100	7
N.	2	N.	3	N.	3	29.914	29.794	29.797	29.835	.155	.193	.216	80	77	91	8
S. E.	1	S. E.	2	S. E.	2	29.777	29.658	29.733	29.723	.236	.440	.481	100	94	94	9
S. E.	1	S. W.	2	S. W.	1	29.775	29.727	29.702	29.735	.472	.521	.368	100	85	96	10
S.	1	S. E.	1	S. E.	1	29.773	29.687	29.614	29.691	.296	.311	.241	100	75	95	11
N.	2	N.	4	N.	5	29.423	29.291	29.247	29.320	.261	.204	.174	100	100	86	12
N.W.	5	N.W.	5	N.W.	5	29.295	29.277	29.416	29.329	.120	.124	.105	79	73	70	13
S. E.	2	S. E.	3	W.	4	29.427	29.203	29.406	29.345	.118	.206	.132	96	86	60	14
N.	3	N.W.	3	N.W.	1	29.795	29.896	29.959	29.883	.150	.103	.126	100	59	93	15
N.	3	W.	4	W.	5	29.611	29.405	29.505	29.507	.136	.180	.139	92	60	64	16
N.W.	3	N.W.	3	W.	5	29.529	29.404	29.343	29.425	.106	.116	.126	79	62	76	17
N.W.	4	N.W.	4	N.W.	3	29.565	29.577	29.707	29.616	.078	.073	.078	83	61	83	18
N.	1	N.W.	5	S. E.	1	29.795	29.906	29.978	29.893	.090	.083	.085	94	66	98	19
S. E.	2	S.	3	S. E.	1	29.980	29.809	29.697	29.829	.117	.136	.185	93	62	79	20
N.	3	N.W.	1	N.W.	1	29.886	29.945	30.059	29.963	.176	.143	.130	82	66	96	21
N.	2	N. E.	1	S. E.	2	30.073	29.991	29.970	30.011	.135	.186	.199	97	98	95	22
S. E.	2	S. E.	1	S. E.	1	29.924	29.881	29.919	29.908	.232	.286	.266	99	91	100	23
N.	1	N.	1	N. E.	1	29.958	29.945	29.968	29.957	.238	.276	.255	100	98	100	24
E.	1	S. E.	3	S. E.	3	29.945	29.976	29.819	29.913	.289	.331	.286	100	89	100	25
S. E.	2	S. E.	2	W.	3	29.664	29.563	29.733	29.653	.300	.425	.198	100	98	82	26
W.	1	N.W.	2	N.W.	2	29.850	29.803	29.766	29.806	.181	.196	.187	95	63	95	27
S. E.	1	S. E.	1	N.	2	29.717	29.708	29.763	29.729	.187	.227	.218	100	100	100	28
S.W.	1	S. E.	2	S. E.	1	29.731	29.507	29.086	29.441	.229	.273	.308	100	100	100	29
N.W.	5	N.W.	5	N.W.	5	29.126	29.337	29.689	29.354	.123	.088	.072	73	62	82	30

Per cent. of Time and Force: N. W. & W. 54; S. W. & S. 8; S. E. & E. 21; N. E. & N. 17.

Barometer: Mean, ... 29.692; Max. . . . . 30.073; Min. 29.086

Vapor: Mean, . . .203; Max. . . .521; Min. . . .072

Relative Humidity: Mean, . . 84; Max. . . 100; Min. . . 36

DECEMBER, 1867.

Day of Month.	Thermometer in the Open Air.				Rain and Snow.				Clouds.					
									7 A. M.		2 P. M.		9 P. M.	
	7 A. M.	2 P. M.	9 P. M.	Mean.	Time of begin'g of rain or snow.	Time of ending of rain or snow.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Amount of cloudiness.	Kind of clouds.	Amount of cloudiness.	Kind of clouds.	Amount of cloudiness.	Kind of clouds.
1	13.8	23.0	15.0	17.3	–	–	–	–	7	Str.	–	–	–	–
2	25.0	30.9	24.0	26.6	Snow, 8 A. M.	9 A. M.	–	–	10	Str.	8	Str.	1	Str.
3	29.0	37.0	29.5	31.8	–	–	–	–	10	Str.	5	Str.	3	Str.
4	26.0	23.0	16.0	21.7	–	–	–	–	2	Str.	–	–	4	Str.
5	12.0	29.2	27.7	23.0	–	–	–	–	7	Str.	2	Str.	8	Str.
6	24.0	34.0	42.0	33.3	3 P. M.	Night.	0.102	–	9	Str.	10	Str.	10	Nim.
7	36.0	34.0	27.0	32.3	–	–	–	–	8	Str.	5	Str.	9	Str.
8	13.8	22.0	15.0	16.9	–	–	–	–	–	–	8	Str.	2	Str.
9	2.5	8.0	3.0	4.5	Night.	–	–	–	1	Str.	–	–	–	–
10	9.0	21.3	10.2	13.5	–	9 A. M.	0.133	1.5	10	Nim.	3	Str.	–	–
11	7.8	24.0	17.5	16.4	–	–	–	–	6	Str.	7	Str.	3	Str.
12	2.7	–1.1	–0.5	0.4	Noon.	Night.	0.135	1.5	10	Str.	10	Nim.	10	Nim.
13	–1.0	10.0	8.0	5.7	–	–	–	–	3	Str.	1	Cir.	–	–
14	–3.0	15.1	15.1	9.1	–	–	–	–	–	–	4	Str.	10	Str.
15	15.0	22.8	20.0	19.3	11 A. M.	1 P. M.	–	–	9	Str.	9	Str.	10	Str
16	22.2	25.0	19.8	22.3	*	–	–	–	10	Nim.	9	Str.	–	–
17	18.7	29.4	27.5	25.2	†	–	–	–	8	Str.	10	Nim.	10	Str.
18	17.8	24.3	11.5	17.9	–	–	–	–	1	Str.	1	Str.	–	–
19	2.7	15.5	1.5	6.6	–	–	–	–	–	–	–	–	–	–
20	5.0	13.0	19.8	12.6	9 A. M.	Night.	0.088	1.0	8	Str.	10	Nim.	10	Nim.
21	31.0	37.9	31.5	33.5	Night.	–	–	–	5	Str.	8	Str.	10	Str.
22	31.5	34.0	37.5	34.2	–	Night.	0.613	2.0	10	Nim.	10	Nim.	10	Nim.
23	37.3	25.8	19.7	27.6	*	–	–	–	9	Str.	7	Str.	–	–
24	16.0	29.6	31.2	25.6	–	–	–	–	8	Str.	9	Str.	7	Str.
25	32.0	36.0	36.5	34.8	‡	–	0.385	–	7	Str.	10	Nim.	10	Str.
26	37.0	46.0	38.3	40.4	–	–	–	–	10	Nim.	–	–	–	–
27	34.8	42.0	44.8	40.5	§	–	0.055	–	8	Str.	10	Str.	10	Nim.
28	42.5	42.0	34.9	39.8	–	–	–	–	9	Str.	2	Str.	9	Str.
29	27.0	35.0	26.5	29.5	–	–	–	–	–	Str.	5	Str.	5	Str.
30	22.0	24.0	16.5	20.8	–	–	–	–	9	Str.	7	Str.	–	–
31	8.7	24.0	23.0	18.6	–	–	–	–	5	Str.	8	Str.	10	Str.
	Mean, . . 22.64 Max. . . 46.0 Min. . . –3.0				Sums, . .		1.511	6.0	Mean, ... 5.7					

* Snow Squalls. † A few Flakes. ‡ Sprinkles in Night. § Occasional Sprinkles.

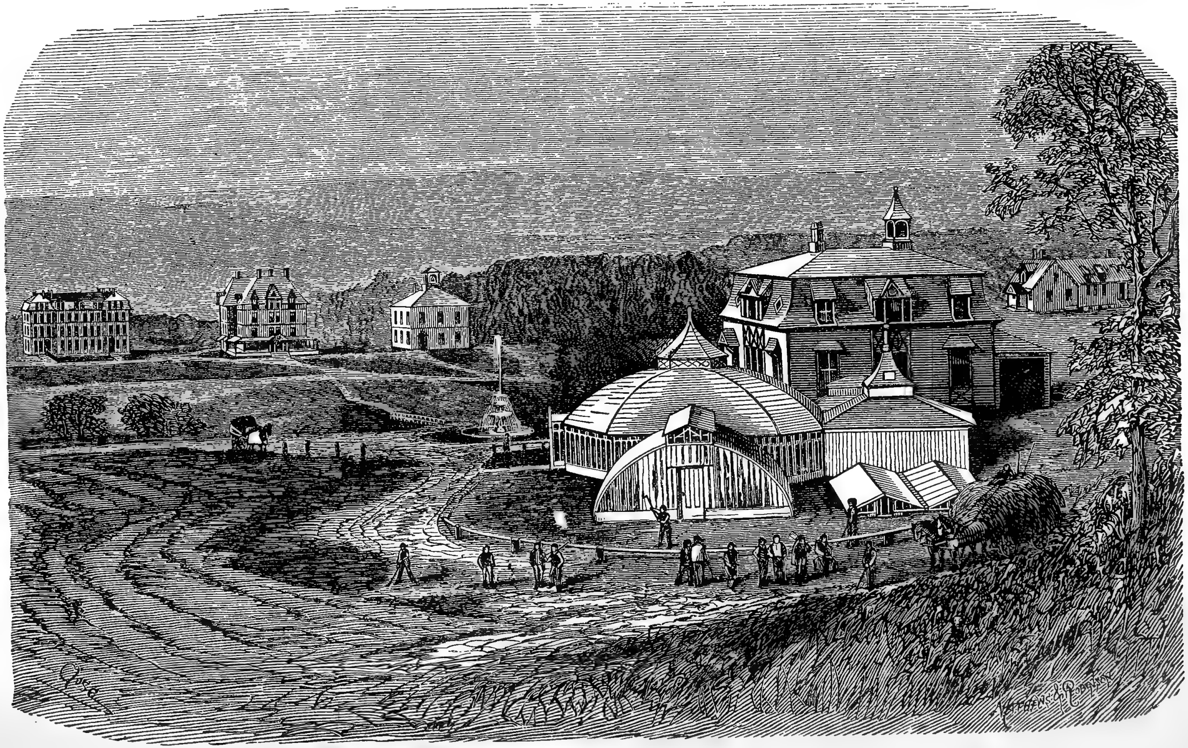
DECEMBER, 1867.—Continued.

Winds. 7 A. M. Direction.	Force.	2 P. M. Direction.	Force.	9 P. M. Direction.	Force.	Barometer. Barometer height reduced to freezing point. 7 A. M.	2 P. M.	9 P. M.	Mean.	Force or Pressure of Vapor, in Inches. 7 A. M.	2 P. M.	9 P. M.	Relative Humidity or Fraction of Saturation. 7 A. M.	2 P. M.	9 P. M.	Day of Month.
N.W.	2	N.W.	3	S. E.	2	29.994	30.075	30.113	30.061	.063	.055	.085	81	45	100	1
S. W.	2	S.	2	N	1	29.976	29.719	29.716	29.804	.117	.159	.129	89	95	100	2
S. E.	1	S. W.	2	S. W.	3	29 709	29.649	29.504	29.621	.156	.133	.134	100	60	83	3
N.W.	3	N.W.	3	N.W.	1	29.494	29.507	29.511	29.504	.097	.062	.084	71	52	96	4
S. E.	1	S. W.	2	N.	1	29.478	29.461	29.640	29.526	.072	.105	.129	100	66	88	5
N. E.	1	S. W.	4	S. W.	2	29.830	29.571	29.217	29.539	.114	.183	.254	89	96	96	6
N.W.	5	N.W.	5	N.W.	2	29.261	29.377	29.480	29.373	.105	.089	.117	51	46	82	7
S. W.	3	W.	4	W.	4	29.730	29.644	29.734	29.703	.067	.086	.073	85	74	87	8
N.W.	3	N.W.	4	S.	2	29.806	29.861	29.884	29.850	.048	.057	.048	100	94	100	9
N.W.	1	N.W.	2	S. E.	1	29.557	29.336	29.621	29.505	.065	.107	.067	100	96	100	10
W.	2	N.W.	2	N.W.	1	29.640	29.625	29.718	29.661	.060	.098	.093	100	76	100	11
N.	3	N.	3	N.	4	29.830	29.745	29.725	29.767	.048	.041	.042	100	100	100	12
N.	4	N.	5	N.W.	5	29.699	29.724	29.821	29.748	.042	.068	.062	100	100	100	13
N.W.	1	N.W.	1	N.W.	1	29.956	29.942	29.931	29.943	.037	.085	.077	100	100	93	14
N.	2	N.	3	N.	3	29.803	29.644	29.558	29.668	.082	.115	.097	95	96	92	15
N.W.	3	N.W.	3	N.W.	4	29.311	29.280	29.388	29.326	.110	.089	.077	93	68	73	16
S. W.	1	S.	2	W.	1	29.451	29.353	29.326	29.327	.084	.159	.150	88	100	100	17
W.	1	W.	4	W.	1	29.558	29.652	29.868	29.693	.095	.098	.071	100	76	100	18
N.W.	3	N.W.	3	N.W.	1	30.132	30.206	30.300	30.213	.049	.065	.044	100	74	100	19
N.W.	1	N. E.	1	N.	1	30.230	29.935	29.785	29.983	.054	.076	.103	100	100	100	20
N.W.	1	N.W.	1	S. E.	3	30.051	30.138	30.127	30.105	.170	.136	.136	100	62	78	21
S.	1	E.	1	S. E.	3	29.854	29.447	29.283	29.528	.174	.191	.221	100	100	100	22
N.W.	4	N.W.	5	N.W.	4	29.273	29.435	29.806	29.505	.136	.102	.089	62	77	84	23
N.W.	2	S. W.	3	S. W	4	30.025	29.899	29.783	29.902	.086	.123	.145	100	77	84	24
S. E.	2	E.	1	S. E.	3	29.912	29.936	29.780	29.876	.162	.198	.180	90	96	85	25
N.W.	2	N.W.	3	W.	3	29.393	29.610	29.852	29.618	.217	.179	.165	100	58	72	26
S. E.	3	S. E.	2	S. E.	4	29.800	29.528	29.330	29.553	.176	.231	.298	88	87	100	27
N.W.	4	N.W.	4	N.W.	1	29.490	29.607	29.774	29.624	.197	.170	.158	74	63	79	28
S. E.	2	N.W.	4	W.	3	29.760	29.790	29.955	29.835	.141	.111	.106	100	55	76	29
N.W.	3	N.W.	4	N.W.	3	30.072	30.069	30.180	30.107	.087	.077	.074	75	61	85	30
N.W.	2	S. E.	2	S. E.	2	30.283	30.194	30.143	30.207	.062	.097	.081	100	79	65	31
Per cent. of Time and Force: N. W. & W. 56; S. W. & S. 15; S. E. & E. 15; N. E. & N. 14.						Mean, . . . 29.731 Max. . . . 30.300 Min. . . . 29.217				Mean, . .111 Max. . . .298 Min. . . .037			Mean, . . 87 Max. . . 100 Min. . . 45			

SUMMARY, 1867.

MONTHS.	THERMOMETER IN THE OPEN AIR.			RAIN AND SNOW.		CLOUDS.	WINDS. Per Cent. of Direction.				BAROMETER. Barometer height reduced to freezing point.			FORCE OR PRESSURE OF VAPOR, In Inches.			RELATIVE HUMIDITY OR FRACTION OF SATURATION.		
	Maximum.	Minimum.	Mean.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Mean amount of cloudiness.	N. W. & W.	S. W. & S.	S. E. & E.	N. E. & N.	Maximum.	Minimum.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
January, . .	33.5	-5.0	18.30	1.324	15.0	5.0	67	4	11	18	30.167	29.013	29.556	.166	.034	.092	100	52	91
February, .	50.0	8.0	31.23	3.646	7.0	6.3	53	22	19	6	30.584	29.073	29.791	.295	.060	.152	100	53	86
March, . .	53.0	8.0	30.84	3.115	14.0	6.3	48	5	12	35	30.221	29.075	29.762	.279	.060	.146	100	43	84
April, . .	66.0	29.0	45.49	3.791	–	4.9	40	28	16	16	30.109	29.157	29.598	.442	.097	.224	100	24	74
May, . . .	75.5	36.0	54.05	4.610	–	5.9	36	23	27	14	30.223	28.991	29.571	.565	.124	.319	100	32	76
June, . .	85.0	54.0	67.06	5.672	–	4.9	21	16	48	15	30.016	29.306	29.756	.820	.309	.534	100	40	82
July, . .	90.0	55.0	68.14	4.000	–	5.2	38	18	24	20	30.025	29.397	29.661	.977	.348	.572	100	46	85
August, . .	83.5	48.3	68.56	9.161	–	5.3	22	23	42	13	29.983	29.386	29.716	.943	.293	.618	100	49	91
September, .	80.0	39.0	59.99	1.107	–	5.1	34	14	32	20	30.216	29.379	29.807	.782	.172	.460	100	43	86
October, . .	76.0	27.0	49.90	3.845	–	4.1	44	12	23	21	30.233	29.319	29.780	.567	.143	.293	100	37	82
November, .	65.0	17.5	37.87	4.305	2.5	6.0	54	8	21	17	30.073	29.086	29.692	.521	.072	.203	100	36	84
December, .	46.0	-3.0	22.64	1.511	6.0	5.7	56	15	15	14	30.300	29.217	29.731	.298	.037	.111	100	45	87
Year, . .	90.0	-5.0	46.17	46.087	44.5*	5.4	43	16	24	17	30.584	28.991	29.700	.977	.034	.310	100	24	84

* Winter of 1866-7, 48.0.



MASSACHUSETTS AGRICULTURAL COLLEGE.

SIXTH ANNUAL REPORT

OF THE

TRUSTEES

OF THE

Massachusetts Agricultural College.

JANUARY, 1869.

BOSTON:
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1869.

ANNUAL REPORT.

To the Honorable Senate and House of Representatives:

The Trustees of the Massachusetts Agricultural College respectfully submit the following Report, in accordance with the requirement of its charter, and of the law of the United States granting lands for its endowment.

The liberal appropriation of $50,000 by the last legislature has proved in the highest degree beneficial, not only in furnishing necessary means for the development of the institution, but in disarming opposition, overcoming prejudice and securing the confidence and sympathy of the public. The general feeling during the year, as represented by the agricultural and other papers, has been exceedingly friendly, and the kindest and most hopeful sentiments have been expressed by many distinguished citizens of this and other States who have visited the institution.

There can no longer be any doubt that there is an abundant demand for the education which the plan of organization adopted is designed to afford. Notwithstanding the numerous changes and the constant distraction inseparable from the building operations of the past year, the students have been as deeply interested and as successful in their studies as could be desired. The peculiar character of the course of study renders it difficult for persons to enter the regular classes except at the beginning of freshman year, so that the size of the classes will unavoidably diminish up to the time of graduation; and this may be expected to occur to a much greater extent than in the older colleges, because there are so few institutions of a like character from which the membership can be replenished.

While it is indispensable for the highest success of the College, as a professional school, that its regular course be very

thorough and complete, it is perhaps equally important that it should offer every possible facility to those who choose to follow a select course adapted to their individual circumstances and necessities. It has hitherto been impracticable to furnish rooms and instruction to any considerable number of this class, and not until quite recently have they been invited to become members of the institution. It is evident that, as soon as the requisite supply of buildings, apparatus and teachers can be obtained, so that instruction may be given every year in all the studies of the course, there will be a large attendance of young men, designing to be farmers and eager to acquire the latest and best information respecting their chosen profession. As students of this class will generally be mature, industrious and specially interested in the departments of agriculture and horticulture, their influence upon the members of the regular classes, under suitable management, will be of a desirable character.

Scholarships.

Nearly all the agricultural societies of the State have shown their interest in the College by voting to pay the term bills of one or more students, the amount per annum for each being $54. As an excellent sample of the mode of proceeding in the choice of scholars, the following statement is extracted from the report for 1868 of the Worcester North Agricultural Society:—

"The Committee to which was intrusted the duty of awarding the Scholarship established in the Massachusetts Agricultural College by the Trustees of this Society, sent a copy of the following circular to each member of the Board of Trustees.

"'*To the Trustees of the Worcester North Agricultural Society:*

"'You are hereby notified that the undersigned will be in session at the hall on the grounds of the Society, on Tuesday, the 4th day of August, at half-past one o'clock, P. M., for the purpose of awarding the Scholarship of the Society in the Massachusetts Agricultural College.

"'Students proposing to compete for the scholarship must be 15 years old, of good moral character, and will be examined in English grammar, geography, arithmetic, and in algebra to quadratic equations.

"'It is earnestly desired that the trustees in each town will induce at least one young man to present himself as a candidate. We believe that no educational institution offers a better general and special education to its students than the Massachusetts Agricultural College. As agriculturists we should desire to give it such aid and encouragement in its infancy as to place its permanent success beyond question.

"'In making your selections, it will be proper to give a preference to persons of limited means, and particularly to such as propose to devote themselves to agricultural pursuits.

"'JABEZ FISHER,
"'JOHN BROOKS,
"'SOLON CARTER,
"'*Committee on Scholarship.*

"'FITCHBURG, July 20th, 1868.'

"At the date therein named, three candidates presented themselves, and after a written, competitive examination, lasting five hours, the scholarship was awarded to Wm. E. C. Whitney of Harvard.

"He has since passed a satisfactory examination at the College and is now pursuing his studies as a member of the freshman class.

"JABEZ FISHER, *Chairman*."

At the present time the following societies maintain scholarships, viz.: The Massachusetts Society supports three; Essex and Plymouth two each; Barnstable, Bristol, Bristol Central, Berkshire, Franklin, Hampden, Hampshire, Hampshire, Franklin and Hampden, Hingham, Highland, Middlesex South, Norfolk, Worcester, Worcester North, Worcester South-East, and Worcester West, one each.

There are many indigent young men who would gladly secure a college education if they could enjoy the benefit of a scholarship, and it is confidently hoped that from time to time gifts and bequests may be made to the corporation for the establishment of scholarships and prizes, which may serve to stimulate, encourage and help worthy students in the effort to prepare for an influential and useful life.

LABOR FUND.

There is, however, another method of assisting indigent students, which is peculiarly suited to the circumstances and

object of the College, viz.: to furnish them labor at fair wages whenever they desire it, both in term time and in vacation, except perhaps in the winter, when they could earn more in teaching or some other business, and when their work on the farm would be less valuable than at other seasons. This employment of students for money has been practised during the past year and with satisfactory results. A large amount of farm work has been performed, and the young men have proved faithful and industrious. As, however, the College has no funds to appropriate to this object, and a large proportion of the labor must be expended on improvements, or products to be consumed on the premises, it is obvious that only a limited number can thus be assisted. Suppose, on the other hand, liberal-minded and large-hearted friends of agriculture and education should establish a fund of say $100,000, the income of which should be expended for the labor of students on the farm and in the garden, several most desirable things would be accomplished.

First. Young men would be aided in such a way as to preserve their self-respect, and their habits of industry and manual labor.

Secondly. The College having such a fund would never lack for students of the best character.

Thirdly. It would render it possible not only to manage the farm with due reference to pecuniary profit, but also to adopt and carry out a suitable system of improvements, and to perform such experiments for the benefit of agriculture as the object of the institution demands.

Fourthly. It would enable the director of the horticultural department to proceed with the important work of laying out, planting and keeping in proper condition the botanic garden, the arboretum, the nursery, the orchards and the vineyards.

Would not money given to such a fund yield a most satisfactory per cent. of blessing to the world, and thus of good to the giver? When the national government has provided the estate and the endowment, and the Commonwealth has liberally granted buildings and appliances for instruction, there surely must be some among the wealthy friends of the College who will contribute of their abundance to a Labor Fund.

Faculty and Students.

With the addition of a new class, changes in the faculty became necessary. Prof. E. S. Snell, of Amherst College, who, temporarily, during the first year, performed with entire acceptance the duties of professor of mathematics, has given place to Prof. S. F. Miller, of Chicago, Ill.

Prof. Miller is a graduate of Amherst College, who has had many years of experience as a civil engineer, engaged in locating and building railroads in the West. He is admirably qualified to instruct in mechanical and topographical drawing, surveying and civil engineering.

Prof. C. A. Goessmann, of Syracuse, N. Y., has been elected professor of chemistry, and enters upon the duties of his department at the beginning of the next term. He is a graduate of the German university of Göttingen, where he taught analytical and organic chemistry for five years after his graduation. During the last six years he has had the superintendence of the manufacture of salt at the works of the Onondaga Salt Company, near Syracuse; and by the improvements there introduced, as well as by his published memoirs upon the salines and salt deposits of the country, has won a wide reputation as a practical and scientific chemist. His large experience as a teacher, and his great familiarity with the applications of chemistry to the arts, qualify him, in a peculiar manner, for the important position of chemist in the Agricultural College. It is confidently expected that, under his supervision, analyses of commercial fertilizers will be made, and suitable experiments instituted, to determine for what purposes and at what prices the farmers of the State should employ them. A collection of material for such investigations has already been begun, and all persons interested are invited to communicate with Dr. Goessmann on the subject.

The laboratory has been well furnished with tables, furnaces, apparatus and chemicals, so as to afford good accommodations for fifty students.

Analyses of soils, ores, waters, &c., will be made, and scientific advice given, upon application at the College.

During the past term, Hon. C. L. Flint has given a course of lectures upon the dairy and dairy farming, Dr. Calvin Cutter

one upon the laws of health, and Dr. J. H. Stickney, V. S., one upon the diseases of domestic animals.

Next term, Prof. Goessmann will lecture upon chemistry, Dr. Jabez Fisher upon market gardening, and Prof. Stockbridge upon agriculture. During the summer term, lectures will be delivered by the president upon botany, by Dr. Edward Hitchcock on comparative anatomy, and by Hon. Marshall P. Wilder on the culture of fruits and flowers, and the art of producing new and valuable varieties.

During the first twelve months from the opening of the college, there were admitted, on written examinations, ninety-six students, of whom ninety-two were received as freshmen for the regular course. Seventy-four of them, at the time of admission, were acquainted with farm work, and thirty-five intended to become farmers, while forty-three were undecided as to their future business. Their average age was nearly eighteen years. The number in each of the three classes, and the localities from which they come, will be seen by reference to the catalogue appended. The general conduct of the students has been all that could be desired, and it is especially worthy of remark that there was no case of "hazing" during the past year.

The department of gymnastics and military tactics has been under the direction of Prof. H. H. Goodell, and has been managed with energy and success. The sophomore class have been thoroughly drilled in the school of the soldier and of the company, and have become expert in the manual of arms. The freshmen have been drilled in light gymnastics, and are prepared to commence military tactics whenever arms and a suitable drill-hall are provided.

The health of the students has been most excellent. No death has occurred, nor any case of alarming illness. The average absence from duty, on account of sickness or wounds, has amounted to less than one day for each student during the entire year. The average for the summer term, ending August 5th, was less than one half day for each person.

Buildings.

An admirable photograph of the college buildings having been recently made by Mr. J. L. Lovell, of Amherst, it has been

engraved upon wood by Hammatt Billings, Esq., of Boston, and electrotyped for this Report. The point of view is on the Mt. Pleasant ridge, near the east line of the estate; and the observer looking to the west, sees in the foreground the Durfee plant-house; the botanic museum, with the fountain in front, presented by the ladies of Amherst; to the right of this, and beyond it, the new boarding-house. Near the centre of the picture is seen the laboratory; to the left, or south of it, the new dormitory; and south of that, the dormitory erected in 1867.

The new dormitory is a substantial edifice of brick, covered with slate, finished inside with chestnut, piped for gas, and furnishing fine accommodations for sixty-four students. It is 100 ×50 feet, four stories in height, and provided with a light basement ten feet high. It was designed by George Hathorne, Esq., of New York, and built by Mr. L. N. Granger, of Hadley, who deserves great credit for the energy displayed in completing the entire job according to contract, so that it was ready for use on the 10th of September. The expense of this building was $36,000, which includes the services of the architect, the grading and the stoves.

The new boarding-house is a large, plain structure of wood, which cost, with the furniture for the kitchens and dining rooms, about $8,000. The present building affords ample accommodations for a family and one hundred table boarders, and is so planned that its capacity can be doubled at a small expense by adding another dining room north of the kitchen.

The best of the old barns and sheds upon the farm have been grouped together near the north line, and repaired at a cost of about $2,500.

Horticultural Department.

The out-door operations in this department have been confined principally to the preparation of the land designed for permanent plantations of fruit and ornamental trees, vines, shrubs and herbaceous perennials. The beautiful slope south of the plant-house, which was underdrained, limed and planted with corn last year, has been laid down to grass. It will thus be useful and pleasant to the eye, until finally occupied as a botanic garden. The central portion of the Mt. Pleasant ridge,

intended for orchards and vineyards, has been heavily manured and broken up, and produced the past season a fine crop of corn. It is now ready for planting with apples, pears, peaches, grapes, &c., as soon as suitable trees and vines can be obtained. Gifts of this kind would be most gratefully received. A nursery of trees and shrubs has been planted at the north end of the ridge and will be enlarged as circumstances will permit, with the purpose of having constantly on hand an abundant stock of all desirable trees and plants which are hardy in Massachusetts, both for planting, for exchange and for sale.

Upon the southern portion of the ridge it is proposed to plant an arboretum, where will be grouped according to their natural affinities and the principles of landscape gardening, fine specimens of all woody plants which will endure our climate.

A gentleman, distinguished for his knowledge and love of trees, has promised to aid in a liberal manner in the laying out and future care of such an arboretum, the beauty and utility of which will be obvious to all.

The Durfee plant-house has been the centre of attraction for the numerous visitors, who have honored us by their presence, and by the completeness of its arrangement and the appearance of its contents has served as an excellent specimen of the manner in which the model farm and garden of the College is designed to be equipped and managed, as soon as other friends shall imitate the noble example of its generous builder.

A catalogue of the plants now under cultivation is appended to this Report, and most of them have been propagated, so that a supply for sale or exchange is constantly on hand. Communication has been opened with some of the leading European establishments which will forward directly to the College the most desirable new varieties and species as soon as offered in market. Persons disposed to aid this department will confer a favor by furnishing any interesting plants not on the list, either as a donation or in exchange.

As all money derived from the sale of plants will assist in the support and development of the collection, it is hoped that parties interested will purchase here bedding and other plants as they may need them.* Seedlings of the Victoria Regia can be

* Orders addressed to Mr. John Griffin, Agricultural College, Amherst, Mass., will meet with prompt attention, and be filled with good plants at low prices.

furnished in the spring, and it is believed that if planted in a sheltered, sunny pond or tank in the open air in June, they would grow to fair size and probably blossom.

The seeds from which the present supply has come were ripened in the open air on the grounds of the Tennessee Hospital for the Insane, near Nashville, and kindly presented by the superintendent, Dr. W. P. Jones.

Agricultural Department.

The instruction in this department has been given, as heretofore, by Hon. Levi Stockbridge, who has lectured once a week through the year and heard daily recitations during the fall term in Waring's Elements of Agriculture. He has also directed the labor of the students in the field and given such practical lessons as were required. In consequence of the want of farm labor, suitable live stock and barn accommodations, little progress has been made in the improvement of the estate. The building operations, which were absolutely indispensable in order to provide room for the new class in September, demanded the labor of teams and men often to the detriment of farm work. The ordinary crops were, however, cultivated and harvested as usual. The amount of hay and corn secured in good order was large, as will be seen by reference to the farm inventory appended.

The following suggestions respecting the general management of the farm which have been made by Superintendent Stockbridge and approved by the Trustees, will serve to indicate the course to be pursued in the future, so far as circumstances will allow.

The college estate consists of nearly four hundred acres of land, with a diversity of soil, elevation and aspect, including woodland for timber and fuel, and to illustrate the art of forestry; fields adapted to the growth of both natural and cultivated grasses, and suited for pasturage and mowing; soils fit for the cultivation of all kinds of grain and root-crops, and localities suitable for all the fruits of our climate. This tract of land it is proposed to convert into a model farm for the double purpose of giving the young men gathered here an opportunity to learn agriculture in its best form, and of affording the farmers of the State facilities for acquiring information

respecting farm management, stock, crops, fertilizers, implements, and every kind of agricultural improvement.

While this will require a vast expenditure of time and labor as well as money for its complete development, it is evident that a general plan of management, based upon correct principles, should be at once adopted and kept in view in all subsequent operations. In the consideration of the subject, the first topic to suggest itself is the division of the farm into woodland, pasture, permanent mowing, and land for tillage. As the land east of the old county road and grove on the Mt. Pleasant ridge is already appropriated to horticultural and botanical purposes and is not under the control of the farm superintendent, it need not be included in the subdivision of the farm proper, nor in any plan for its improvement.

The timber land is conveniently situated and should not be disturbed, except that all the open woods scattered through the west pastures should be removed.

The permanent top-dressed mowing should include all the fields bounded by the south line of the farm on the south, the old county road, and the grove on the Mt. Pleasant ridge, on the east, the north line of the farm on the north, and a line, central on the chestnut-tree ridge, on the west.

The fields for tillage, crop-rotation and experiment, should be those lying between the west line of the mowing above described and the fence at the Hadley line, and extending from the north to the south boundary of the farm.

The pasture lands should be that portion of the estate west of the Hadley line which is not covered with timber.

The fences should be as few as possible, but straight and well built of posts and boards. It will be obviously necessary to fence the county road sufficiently to prevent cattle, which are constantly driven over it, from strolling into the mowing on either side. As soon as a hedge can be grown this fence may be removed. The boundary line should be well fenced and the pastures subdivided by cross fences, and separated from the land devoted to other uses. There should also be lanes fenced off on the north and south lines of the estate to guide the cattle to and from the barns and to the highway and pastures.

The public roads running through or adjoining the college property are so located as to be very convenient for farm pur-

poses, so that but a small amount of additional road will be necessary to secure access to every desired point. Ultimately, when the pasture lands in Hadley are improved, a farm road will be required across the estate near the town line, but is not wanted at present.

The farm buildings should be so located as to be most accessible from that portion of the farm to and from which there will be the most cartage. This will be about on the centre of chestnut-tree ridge, at the dividing line between the divisions already set apart for permanent mowing and for tillage. This land is admirably adapted for building purposes, and the central portion is already occupied by the college edifices. As the farm is very large it will produce, when brought into a high state of cultivation, five hundred tons of hay and other long fodder. It is not prudent to place so much combustible material of value, with the stock necessary to consume it, in one barn. It will, therefore, be necessary to have two sets of farm buildings, one on the southern and the other on the northern portion of the central ridge. One of the farm houses should be occupied by the farm superintendent and the other by the farmer, who should have the immediate oversight of the teams, tools, stock and labor on the premises, under the direction of the superintendent.

The farm having been properly subdivided and furnished with necessary buildings as indicated, should next be supplied with as much live stock of the best kinds as it will carry both summer and winter. The great work of permanent improvement is then to be begun and pursued as rapidly as can be done with due regard to economy. As it is necessary to preserve the proper balance of the different portions of the farm, which has been an object in the division adopted, the amelioration of the various parts must be brought about gradually and at the same time.

The mow lands first demand attention because they are contiguous to the highway and at present wet, rough and unproductive. The fields of this division slope towards the brook, which has a rapid fall. They are all surcharged with water, which breaks out in springs in many places, running over the surface, making the soil cold and barren, and inducing the growth of coarse, undesirable grasses. These fields should be

under-drained in the most thorough manner, plowed, have the holes and gullies filled, the boulders taken out or sunk, and then be top-dressed, re-seeded and kept as permanent mowing. The drains will open at the level of the brook, which should be first straightened and made wider. This is a great and costly undertaking, but is absolutely necessary. It cannot all be done at once, nor is it desirable that it should be. No large appropriations should be made, to be expended in season or out of season, just as may happen, but a system for the whole should be adopted, and then, as time and circumstances favor, let the work be continually going on. This process should begin at the south line of the farm and continue until all the land between the college road on the west and the grove on the north-east has been renovated.

Most of the tillage lands need only high manuring, with a judicious rotation of crops, to bring them into fine condition, but the slope from the Hadley line for a distance of from twenty to thirty rods eastward, must be under-drained before it can be properly improved.

The pasture lands on the river, which bounds the estate on the west, have the best soil of the farm, but much of it is saturated with water and covered with brush, and should be improved immediately.

This section would also be greatly benefited by under-draining, but as this cannot be done at present it should be cleared of brush and scattered timber with the ax, the scythe, and sheep, and have the surface water removed by open drains.

How, when and by whom shall this work of improvement be done? Negatively not by a large appropriation and the employment of a large extra force to come upon the farm for a short time and do the work at all hazards of cost, whether the weather, the season and the circumstances of the farm crops and operations favor or not, but by the students and a regular force of good men employed by the month, who shall be a rallying point for the boys, and make this labor available and profitable. This method will accomplish the work better, more economically, will be more beneficial to the students, and will require but a comparatively small annual appropriation beyond the farm income.

The great want of the time is the application of known principles of science to the practical business of life. And this is eminently true of the agriculture of our State. The chief object of this institution is, to meet this want by giving to the young men of Massachusetts, especially those of limited means, an opportunity of acquiring a thorough education of that scientific and practical character which will qualify them to superintend and manage successfully the most important business operations, but chiefly those of horticulture and agriculture, and ultimately through them to give to the industrial pursuits of our people that intelligence and direction needed to increase their productive power to the highest point. Their instruction in all the practical details of the farm, and of business connected therewith, as well as in the principles that underlie all intelligent, successful practice, devolve to great extent on the farm superintendent and professor of agriculture. The proficiency and character of the students in this regard will depend very much on the manner in which this officer discharges his duties, and makes his position one of great responsibility and importance. He should, therefore, be well educated and prepared for his position, and be furnished with abundant facilities to aid him in his work. In consequence of the crude and undigested condition of our agricultural knowledge, of the lack of suitable text-books, and a generally accepted system of agriculture, his duties should be so arranged as to give him the necessary time and freedom of thought for investigating and establishing agricultural facts, and to instruct his pupils individually in everything that relates to the most correct practice. In the present condition of the institution this officer is the "man of all work." A portion of the year he is daily in the school-room as a teacher, he lectures weekly, he must take his class to the farm daily for practice in the manual of agriculture. He must plan all general farm work and improvements, and personally superintend the carrying out of those plans, take charge of and keep the time of the paid labor of students and men, look to the condition of the stock and crops, have the general supervision of the teams and tools, and examine and report on all implements and machines left for trial, must keep the farm books and accounts, attend to all the outside business of the farm, with his own hand perform such farm labor as

requires skill and experience, and be ready at all times to give attention to the visiting public who seek information respecting the agricultural department. It is therefore important that the duties now assigned to one individual should, as soon as circumstances will admit, be divided and assigned to two persons, —a professor of agriculture and farm superintendent, whose duty it shall be to give instruction in agriculture in the lecture-room and field, and to have the general direction and planning of all farm operations and improvements; and a farmer, intelligent, capable and efficient, who shall have the personal oversight of all the details of farm labor and keep the time of hired men and of students who work for pay, and be responsible to the superintendent for the discharge of his duties. It would cost more to pay such a farmer than it does to pay a mere laborer, but the result would be to so thoroughly systematize and direct all paid labor that it would make it more profitable; there would be less waste and loss of time and material, and a saving would be made in this regard that would go far toward paying the salary of the farmer. In this case the superintendent, if he be a suitable person, will be able to use his time and thoughts more efficiently in the theoretical and practical instruction of his pupils, and in devising and elaborating his general plans and experiments.

Trial of Plows.

The New England Agricultural Society, in May last, held upon the college farm a grand trial of plows, which continued through four days, and was attended not only by the officers and committees of the society, but also by many of the leading manufacturers of agricultural implements, reporters of agricultural papers, and the farmers of the vicinity. As a detailed statement of the premium list, programme of exercises and reports of committees has been published in the annual transactions of the society, it is unnecessary to repeat them. The students of the College were deeply interested in the proceedings, and appointed a committee of five, who prepared an elaborate report upon the whole subject for the consideration of their comrades.

The committees were instructed to pay particular attention, in their examinations of plows, to the following points, viz.:

pulverizing power, non-liability to choke in stubble, lightness of draft, ease of holding, durability, cheapness, excellence of mechanical work, excellence of material, thorough inversion and burial of weeds, even distribution of wear, and regularity in turning and carrying the furrow slice on sod.

The number of plows entered for premium was twenty-nine, and included almost every valuable variety, except the steam plow, which is now becoming so popular in England. There were, besides the ordinary forms, the swivel plow, which may be reversed at the end of every furrow; the gang or California plow, capable of turning from one to seven furrows at a time; the sulky plow, on which the plowman rides; and the self-holding plow, which requires scarcely any attention, and retains its proper position, even in turning, in a remarkable manner. The plows were arranged in eight classes for trial, and were thoroughly tested in the kind of work they were specially designed to perform. The successful competitors were the Ames Plow Company of Boston, the Collins Company of Collinsville, Conn., Taylor and Belcher of Chicopee, C. W. Sykes of Suffield, Conn., and J. H. Morse of Boston.

After the trial of plows, Dr. George B. Loring, president of the New England Society, delivered an instructive address upon plows and plowing, which was followed by an interesting discussion. The substance of the remarks seemed to be that, with all the modern improvements, a perfect plow was not yet invented, and that while it is possible to make a plow that would work well in different soils and at different depths, still a universal plow for every kind of work was not likely to be devised.

It is understood that the New England Society proposes to institute a grand trial of mowing machines at the College in June next, of which due notice will be given.

These important trials of agricultural implements are made at the expense of the society.

Meteorological Register.

The Act of Congress, granting land for the endowment of the College, requires that "an annual report shall be made regarding the progress of each college, recording any improvements and experiments made, with their cost and results, and such other matters including State industrial and economical statis

tics, as may be supposed useful, one copy of which shall be transmitted by mail free, by each, to all the other colleges which may be endowed under the provisions of this act, and also one copy to the secretary of the interior."

In accordance with this requirement is added a register of meteorological observations, giving the complete statistics of the weather at Amherst for the year 1868, accompanied by remarks from Professors Snell and Stockbridge upon the peculiarities of the past season, and their effects upon the growing crops. It is regarded by those interested in agricultural improvement as very important that such tables be printed and distributed among the farmers, that they may be able the better to judge of the effects of temperature, sunshine and moisture upon their experiments with fertilizers, special crops and modes of culture.

The Michigan Agricultural College has for many years published with its annual report such a register. When colleges in all the States shall do this, a vast amount of valuable information respecting the climate of the whole country will be accumulated at each institution, and can hardly fail to afford important truth for the benefit of agriculture.

Board of Agriculture.

The relations of the Board to the College have been of the pleasantest kind. A committee consisting of Prof. Louis Agassiz, Hon. George A. King, and Capt. John B. Moore, have attended the examinations of the students, and inspected all the operations of the College, and will report at the annual meeting in Boston. The usual session for lectures and discussions, commonly called the "country meeting," was held at Amherst, December 8th, 9th and 10th, and was admitted by all to have been remarkably successful. Among the numerous speakers may be named Prof. Agassiz, Dr. Loring, Prof. Gamgee, J. F. C. Hyde, Esq., Hon. M. P. Wilder, President Clark, Superintendent Stockbridge, Col. M. C. Weld, Dr. Nathan Durfee, Rev. William Clift, Hon. T. S. Gold, Hon. S. L. Goodale, X. A. Willard, Esq., Richard Goodman, Esq., Alexander Hyde, Esq., Hon. E. W. Bull, Capt. J. B. Moore, Dr. Jabez Fisher, and many other distinguished agriculturists. A phonographic record of the proceedings will be printed in the

forthcoming report of the Board, which will be found replete with interesting and useful knowledge.

Immediate and Prospective Wants.

Massachusetts, in proportion to her population, has doubtless raised by direct taxation and expended more money for educational purposes, and made more liberal appropriations for the promotion of her agricultural interest than any other State of our Union or any other government in the world. The beneficial results of these large expenditures for such worthy objects are sufficiently familiar and satisfactory to all her citizens. Dr. Edward Hitchcock, in his report concerning an agricultural school, made to the legislature of 1851, in earnestly recommending the establishment of such an institution, says, "to advance our agriculture is to give a new impulse to all other industrial pursuits; nay, to all our great interests, economical, political, social and moral." After nearly twenty years of earnest effort, accompanied by ample illustration of the adage that "every beginning is difficult," a college for the education and training of young men for practical life and especially for farming has been organized and successfully started upon a plan which meets with general approval. It has received from the United States $168,000 for a farm and an endowment; from the town of Amherst, $75,000, for the erection of buildings; from the State, $70,000, for building and other expenses, and from individuals $20,000 for special purposes. The sum of $125,000 has been applied in the construction of two large dormitories, containing each 32 suites of rooms, affording excellent accommodations for 128 students, whenever they can be devoted exclusively to this use; two boarding-houses, a chemical laboratory, a plant-house and botanic museum; and to the purchase and repair of several old houses and barns upon the estate.

The College began with a freshman class, October 2d, 1867, received another last September, and, next fall, should be prepared for a third. The second and third years are those in the course of study particularly devoted to the natural sciences and to agriculture and horticulture. It is of the utmost importance therefore in order that justice be done to those who first entered the institution, and to conform to the published

programme of studies, that the necessary buildings, apparatus and live stock be procured for the proper and thorough instruction of the sophomore and junior classes. To do this will require the expenditure of $100,000 the ensuing year, for the following objects, viz.:—

1. A barn, 100 by 50 feet, of wood.

A committee of the Board of Agriculture has undertaken to prepare a plan for such a structure as shall be at once economical and convenient, and it is hoped their report will be of great value to the farmers of the Commonwealth. The estimated cost of the barn is $8,000.

2. A farm house near the new barn for the farm superintendent, to cost $5,000.

This is indispensable for the proper care and safety of the barn and contents and the management of the business of the estate.

3. A supply of soft, running water at all the buildings on the central ridge. This will require the construction of a reservoir on the Mt. Pleasant ridge and the laying of one mile of large cement or iron pipe. A plan has been prepared by Phineas Ball, C. E., of Worcester, for the construction of a reservoir of ample capacity, which, with the laying of the necessary pipe, will cost $5,000.

This is a matter of the utmost importance both for the comfort and health of men and animals and for safety in case of fire.

The fall is sufficient to throw water over any of the buildings, and it might be used for irrigation and for ornamental purposes. It is greatly needed also in the bathing-room and in the chemical laboratory. It seems, from the trials made, to be very expensive and difficult, if not impossible, to obtain good wells on the ridge.

4. A suitable supply of hand implements for students, and the fitting up of a tool room; the erection of necessary fences; moving of long shed and fitting it to the new barn; grading; roads; tile for under-draining, and the purchase of fine, young specimens of the principal breeds of cattle will require at least $10,000.

The above named sum of $28,000 for agricultural purposes is greatly needed for use the present year. The proper training of the students, the profitable management of the farm, and

the reputation of the College, as a professional school, demand that these improvements be made immediately.

5. A building of wood, 100×50 feet, for a gymnasium, drill-hall and armory which, with necessary fixtures, will cost $8,000. The law, both of the State and of Congress, requires that military tactics be regularly taught as a part of the course of instruction, and the State has granted a supply of arms and equipments which have been in use the past year. The building erected for a chemical laboratory has hitherto been occupied for this department, but will hereafter be required exclusively for operations in chemistry. The military and gymnastic drill is of the highest value in developing a symmetrical and graceful form, and giving that erect and manly carriage of the person which is so desirable. With proper facilities every student, during his four years' residence at the College, might become thoroughly familiar with all the duties of a soldier in both the infantry and artillery service, and so qualified to serve at once in the ranks, or as an officer, for which his general education would tend to fit him. Prof. Goodell is an admirable gymnast and tactician, having served as an officer in the army, and, if provided with the building named, would carry out efficiently the requirement of the law. In order, however, to do this without serious interference with the out-door operations of the farm and garden, he must be able to drill his classes in winter and in rainy weather. This would also give to the students the necessary bodily exercise, which they are not otherwise likely to obtain in unpleasant days.

It may be well in this connection to remark that five years ago a commissioner was appointed by Governor Andrew, in compliance with a Resolve passed by the legislature, to prepare a plan for a military academy to be established by the State. Hon. Edward Everett was chairman of the board and wrote their report, which recommended the adoption of a plan for an academy similar to the one at West Point, and requiring for buildings, apparatus and endowment, one million of dollars. By the expenditure of a few thousand dollars in connection with the Agricultural College, results perhaps quite as valuable, even in a military point of view, may now be attained.

6. A public building, 100×50 feet, of brick, to contain in the basement, besides a furnace and work room, an agricultural

museum for a collection of implements, drawings, models, and products of the farm, and a lecture-room; on the first floor, a treasurer's office, a lecture and an apparatus room for the department of physics and engineering and the State cabinet of natural history; on the second floor, a library, reading-room and chapel. A plan for such a building has been sketched by George Hathorne, Esq., of New York, the estimated cost of which is $40,000. The chapel is a necessity, as there is no room on the college premises large enough to seat comfortably three classes of the present size, and a hall suitable for the assembling of all the students for devotional and other exercises cannot be dispensed with. The State collection should be removed from the south dormitory to make room for the new class of 1869. It also ought to be placed where it would be in less danger of destruction by fire than in its present location. The mathematical recitation room, library, and treasurer's office should also be transferred to another building to make room for students, or a third dormitory should be erected next summer.

7. For constructing cases for books, specimens and apparatus; for moving collections and fitting up the lower floor of south college for the occupation of students; for fitting up a bathing-room; for the purchase of books of reference, and for apparatus in the departments of chemistry, physics, engineering, surveying and drawing will be needed the sum of $10,000.

8. For a president's house, of wood, $14,000.

With the constant increase in the number of students and visitors it becomes more and more important that the president should reside in the immediate vicinity of the College, and this becomes almost a necessity in view of the fact that there are as yet no suitable houses for any other members of the faculty upon the estate.

Finally, to complete in a measure the institution and furnish it with the means for educating four classes, of fifty each, there will be required in addition to the $100,000 needed this year, the further sum of $50,000 next year, for the erection of another dormitory, and of houses for the faculty.

The statement respecting the immediate and prospective wants of the College is thus presented with entire frankness and fullness in order that the legislature and the public may

clearly understand their magnitude and their limit. Massachusetts has undertaken to create an Agricultural College, and will never be satisfied with one of an inferior grade. No college of the kind in the United States has to-day a better reputation than the one which bears her name. No one is believed to be more sure of the highest success by those who are interested in such institutions and best able to judge of their merits. The items of expenditure mentioned above as necessary to the complete development of the College will never be less than at present. Nothing will be gained by delay in granting the requisite funds, but much may be lost. If your honorable body, having visited the institution, shall decide that it is worthy of your patronage, we pray you to grant the appropriation asked and throw the responsibility of its future upon the officers in charge. The public confidence and interest in the People's College will thus be increased, and will appear in the large number of students applying for admission, and in the donations which will assuredly come for special objects from wealthy friends, as soon as they are convinced that its foundation is secure. "For unto him that hath shall be given, and he shall have abundance."

Respectfully submitted,
By order of the Trustees,

W. S. CLARK, *President.*

AMHERST, January 1, 1869.

CATALOGUE

OF

TRUSTEES, OVERSEERS, FACULTY AND STUDENTS,

1868.

Board of Trustees.

MEMBERS EX OFFICIIS:

ELECTED BY THE LEGISLATURE:

Executive and Building Committee.

Auditor.

Treasurer.

NATHAN DURFEE, M.D., of Fall River.

Assistant Treasurer.

GEORGE MONTAGUE, Esq., of Amherst.

Board of Overseers.

THE STATE BOARD OF AGRICULTURE.

Examining Committee.

Prof. LOUIS AGASSIZ, Hon. GEORGE A. KING,
Capt. JOHN B. MOORE.

Members of Faculty.

WILLIAM S. CLARK, Ph. Dr.,
President and Professor of Botany and Horticulture, and Director of the Botanic Garden.

Hon. LEVI STOCKBRIDGE,
Farm Superintendent and Instructor in Agriculture.

HENRY H. GOODELL, A.M.,
Professor of Modern Languages and Instructor in Military Tactics.

SAMUEL F. MILLER, C.E.,
Professor of Mathematics.

CHARLES A. GOESSMANN, Ph. Dr.,
Professor of Chemistry.

JOHN S. STICKNEY, V. S., M.D.,
Lecturer on Diseases of Domestic Animals.

CHARLES L. FLINT, A.M.,
Lecturer on Dairy Farming.

CALVIN CUTTER, M.D.,
Lecturer on Hygiene.

JABEZ FISHER, M.D.,
Lecturer on Market Gardening.

EDWARD HITCHCOCK, M.D.,
Lecturer on Comparative Anatomy.

Hon. MARSHALL P. WILDER,
Lecturer on the Culture of Fruits and Flowers, and the Art of producing New and Valuable Varieties.

JOHN GRIFFIN, Gardener.

Sophomore Class.

Allen, Gideon Hammond,	Marion.
Bassett, Andrew Lewis,	Amherst.
Bell, George Henry,	Amherst.
Birnie, William Perkins,	Springfield.
Blunt, Charles Easty,	Nashua, N. H.
Bowker, William Henry,	Phillipston.
Breck, Webster,	Watertown.
Brown, Clarence Eaton,	Florence.
Cary, William Herbert,	Amherst.
Caswell, Lilley Brewer,	Fitchburg.
Cowles, Homer Lucian,	Hadley.
Eastman, George Henry,	Amherst.
Ellsworth, Emory Alexander,	Barre.
Fisher, Jabez Franklin,	Fitchburg.
Fuller, George Elwyn,	Amherst.
Greene, William Henry,	Hadley.
Hawley, Frank Warren,	Hadley.
Herrick, Frederick St. Clair,	Lawrence.
King, Albert,	Taunton.
Leonard, George,	New Bedford.
Lyman, Robert Worthington,	Easthampton.
Miller, Henry Lewis,	South Hadley.
Morse, James Henry,	Salem.
Nichols, Lewis Abel,	Danvers.
Norcross, Arthur Dickinson,	Monson.
Page, Joel Bardwell,	Conway.
Richmond, Samuel Howard,	Taunton.
Russell, William Delano,	Sunderland.
Smead, Edwin,	Greenfield.
Southwick, Alonzo Lewis,	Blackstone.
Sparrow, Lewis Addison,	Medway.
Strickland, George Porter,	Amesbury.
Swift, George Albert,	Charlestown.
Thompson, Edgar Eliab,	Hopkinton.
Tucker, Wilson Morehouse,	Monson.
Ware, Willard Carroll,	Salem.
Wheeler, Charles Albert,	Hopkinton.
Wheeler, William,	Concord.
Whitney, Frank Le Prelet,	Boston.
Woolson, George Clark,	Hopkinton.
Total,	40

Freshman Class.

Ames, William Campbell,	Conway.
Bancroft, Jonathan Franklin,	Tyngsboro'.
Barber, Strong Hayden,	Windsor, Ct.
Barker, Charles Augustus, Jr.,	Charlestown.
Bell, Burleigh Cook,	Winchester.
Blood, Alonzo Hutchinson,	Winchester.
Brainard, John Wilson,	Palmer.
Brett, William Franklin,	North Bridgewater.
Bullard, William Ebenezer,	Royalston.
Chapman, Edward Brown,	Jersey City, N. J.
Clark, John Wesley,	North Hadley.
Cole, Daniel Pomeroy,	Springfield.
Cowles, Frank Colton,	Amherst.
Cowls, Walter Dickinson,	Amherst.
Crocker, Loring, Jr.,	Barnstable.
Cutter, John Clarence,	Warren.
Dyer, Edward Norris,	Shrewsbury.
Easterbrook, Isaac Henry,	Boston.
Fisk, Edward Ransom,	Amherst.
Flagg, Charles Otis,	Westminster.
Grover, Richard Baxter,	Amherst.
Harrington, Frank Warner,	Amherst.
Kimball, Francis Elliot,	Dudley.
Kingman, Willie Hart,	Amherst.
Livermore, Russell Woolcott,	Bozrahville, Conn.
Lockey, John Morse,	Leominster.
Mackie, George,	New Bedford.
Morey, Herbert Ellis,	Malden.
Morris, Frederick William,	Springfield.
Nash, Arthur Henry,	Hadley.
Ober, Frederick Albion,	Beverly.
Penhallow, Charles Lowell,	Portsmouth, N. H.
Shaw, Elliot Dwight,	Chicopee.
Snow, George Henry,	Leominster.
Somers, Frederick Maxwell,	Greenfield.
Swazey, Walter West,	Springfield.
Thomas, George Hutchins,	Lebanon, Ct.
Thompson, Samuel Clarence,	Southboro'.
Wells, Henry,	Stockbridge.
Whitney, William Channing,	Harvard.
Wills, John Wheelwright,	Boston.
Total,	41

Select Course.

Luther, Gardner Clark,	Providence, R. I.
Smith, William Henry,	Stafford Springs, Ct.
Tucker, George Homer,	W. Spring Creek, Pa.
Vose, Edward Faxon,	Marion.
Total,	4

Summary.

Sophomores,	40
Freshmen,	41
Select,	4
Total,	85

COURSE OF STUDY AND INSTRUCTION.

Freshman Year.

First Term.—Algebra; Human Anatomy and Physiology; Chemical Physics.

Second Term.—Geometry; French; Chemistry.

Third Term.—Geometry; French; Botany.

Lectures upon Hygiene, Chemistry, Botany and Agriculture; and Exercises in Orthography, Elocution, and English Composition, during the year.

Sophomore Year.

First Term.—German; Agriculture; Commercial Arithmetic and Book-keeping.

Second Term.—German; Trigonometry; Analytical Chemistry with laboratory practice.

Third Term.—Mensuration; Surveying; Analytical Chemistry; Zoölogy; Drawing.

Lectures upon Comparative Anatomy, Diseases of Domestic Animals, Organic Chemistry, Dairy Farming and Market Gardening; and Exercises in English Composition and Declamation, during the year.

Junior Year.

First Term.—Physics; French or German; Agricultural Chemistry with practice in the laboratory and the field; Drawing.

Second Term.—Physics; Rhetoric; Horticulture.

Third Term.—Astronomy; Systematic Botany; History of the United States.

Lectures upon Physics, Mineralogy, the Cultivation of the Vine, of Fruit and Forest Trees, and Useful and Injurious Insects; and Exercises in English Composition and Debate, during the year.

Senior Year.

First Term.—Intellectual Philosophy; History; Physical Geography.

Second Term.—Moral Philosophy; Political Geography; The Civil Polity of Massachusetts and the United States.

Third Term.—Geology; Engineering; Political Economy.

Lectures upon Stock Farming, Architecture, Landscape Gardening, Geology and English Literature; and Exercises in Original Declamation and Debate, during the year.

Exercises in Gymnastics, Military Tactics, and the various operations of the Farm and Garden, through the course.

DAILY ROUTINE, WINTER TERM, 1869.

At 6 30 a. m., bell for rising; at 7 a. m., bell for breakfast; at 8.45 a. m., bell for prayer; at 9 a. m., bell for study or labor; at 12 m., bell for dinner; at 1 p. m., bell for study or labor; at 5.30 p. m., bell for supper; at 7 p. m., bell for study.

Sundays change as follows:—

At 7 a. m., bell for rising; at 7.30 a. m., bell for breakfast; at 8.45 a. m., bell for prayer; at 10.15 a. m., bell for church; at 3.30 p. m., bell for Bible class.

EXERCISES OF SOPHOMORE CLASS.

At 9 a. m., Manual Labor on Mondays, Wednesdays, and Fridays.

First Division.—At 1 p. m., Laboratory Practice; at 3 p. m., Trigonometry; at 4 p. m., German.

Second Division.—At 1 p. m., German; at 2 p. m., Trigonometry; at 3 p. m., Laboratory Practice.

Saturdays change as follows:—

At 9 a. m., Declamations; at 10 a. m., Compositions or Translations; at 11 a. m., Examination in Analytical Chemistry.

EXERCISES OF FRESHMAN CLASS.

At 9 a. m., Chemistry, Recitation or Lecture; at 10 a. m., Geometry; at 11 a m., French; at 1 p. m., Manual Labor on Mondays, Wednesdays, and Fridays.

Saturdays change as follows:—

At 9 a. m., Reading and Spelling; at 10 a. m., English Composition; at 11 a. m., Lecture on Agriculture.

ADMISSION.

Candidates for admission to the Freshman class are examined in writing upon the following subjects: English Grammar, Geography, Arithmetic, and Algebra, to Quadratic Equations.

Candidates for higher standing are examined as above, and also in the studies gone over by the class to which they may desire admission.

No one can be admitted to the College until he is fifteen years of age; and every student is required to furnish a certificate of good character from his late pastor or teacher, and to give a satisfactory bond for the prompt payment of term bills. Tuition and room-rent must be paid in advance, at the beginning of each term; and bills for board, fuel and washing at the end of every term.

The regular examination for admission is held at the Botanic Museum, at 9 o'clock, A.M., on the second Thursday of September; but candidates may be examined and admitted at any other time in the year.

Further information may be obtained from President W. S. Clark, Amherst, Mass.

CALENDAR.

The next academic year begins September 9th, 1869, and is divided into three terms:—

The first term begins the second Thursday of September, and continues thirteen weeks.

The second term begins the fourth Thursday of January, and continues thirteen weeks.

The third term begins the first Thursday of May, and continues thirteen weeks.

EXPENSES.

Tuition,	$12 00 per term.
Room rent,	5 00 "
Incidental expenses,	1 00 "
Board,	3 50 per week.
Washing,	50 per dozen.
Expenses of Chemical Laboratory, to students of practical chemistry,	5 00 per term.
Public and private damages, including chemical apparatus,	at cost.

REMARKS.

The full course of study occupies four years, and those who complete it will receive the degree of Bachelor of Science. Three recitations, or their equivalent in lectures or literary exercises, are assigned for each day, except Saturday and Sunday. Saturday afternoon is devoted to scientific excursions and recreation. On Sunday all are required to attend church, or Bible class; but in all biblical instruction the inculcation of denominational views is, as far as practicable, to be avoided.

All students are expected to engage in manual labor six hours per week when required, without compensation, for the purpose of learning the various operations of the farm and garden, and those who wish to perform additional work for wages will be allowed to do so and receive pay at the rate of ten cents per hour.

Students wishing to be absent from any assigned duty are expected to ask permission beforehand, whenever that is practicable, and in all cases to present their excuses after an absence to any officer from whose exercise they may have been absent.

A careful record will be kept of the attendance, attainments and deportment of every student, and sent to his parent or guardian at the close of each term, and only such as are faithful, successful and gentlemanly will be allowed to continue members of the College.

Those who pursue a select course will attend recitations and lectures with the regular classes; but persons properly qualified and desiring special instruction in Chemistry, Civil Engineering, Agriculture or Horticulture, will be allowed to make private arrangements with the officers having charge of those departments. During the present collegiate year instruction will be given only to the Freshman and Sophomore classes.

GIFTS.

The following gifts have been made to the College during the past year:—

From the American Unitarian Association of Boston, 33 volumes of religious books and 14 pamphlets.

From Hon. Albert Fearing of Boston, 23 costly volumes of agricultural and horticultural books, including an elegant copy of Hovey's Fruits of America.

From William Knowlton, Esq., of Upton, $50 in cash for purchase of books.

From the Highland Agricultural Society, $50 in cash.

From the Amherst Farmer's Club, 40 volumes of valuable agricultural books.

From Luke Sweetser, Esq., of Amherst, 1 volume, Coleman's Agriculture.

From Rev. C. C. Sewall, of Medfield, 2 volumes on agriculture.

From J. B. Burr & Co., of Hartford, Conn., 1 volume, Dictionary of the Bible.

From Levi P. Warner, Esq., of Sunderland, 1 volume, Facts for Farmers.

From Samuel Batchelder, Esq., of Cambridge, 49 volumes of the Transactions of the Society of Arts. London, 1783—1832.

From Hovey & Nichols, of Chicago, Ill., 10 fruit models.

From William H. Lyman, Esq., of Leverett, 100 varieties of flower and 50 of vegetable seeds.

From Leander Wetherell, Esq., of Boston, 18 volumes of the Journal of the Royal Agricultural Society, London, and a fine collection of the seeds and cones of the evergreens of California.

From J. Q. A. Warren, Esq., of San Francisco, Cal., 1 broom from Californian brush, 2½ feet long.

From E. W. Buswell, Esq., of Boston, fresh and dried seeds and plants.

From Hon. E. H. Sawyer, of Easthampton, greenhouse plants.

From S. D. Tillman, Esq., of New York, 2 volumes, Transactions of the American Institute.

From J. T. Ames, Esq., of Chicopee, stove plants.

From Olm Brothers, of Springfield, 1 banyan tree and 1 guava, large specimens.

From Mr. W. D. Mosman, of Amherst College, 1 banana plant from Cuba.

From Dr. Nathan Durfee, of Fall River, 20 large pine-apple plants.

From Dr. L. W. Puffer, of North Bridgewater, seeds and plants.

From William Richards, Esq., of Sharon, 1 remarkable specimen of herdsgrass.

From P. S. Williams, Esq., of Hadley, plants from Missouri.

From. Hon. S. Williston, of Easthampton, stove plants.

From Prof. P. C. DeLaslier, of Boston, seeds of galega orientalis, a new forage plant.

From Hon. S. L. Goodale, of Saco, Maine, 12 volumes of the Transactions of the Maine Board of Agriculture.

From J. O. Baker & Co., of New York, valuable specimens of phosphatic guano.

From Dr. C. U. Shepard, Jr., of Charleston, S. C., 4 bbls. mineral phosphate of line.

From J. Gould, Esq., of Boston, 3 bbls. of alkaline manure.

From Isaac N. Farnsworth, Esq., of Boston, 40 volumes of Flint's Dairy and Dairy Farming, presented to the Sophomore class.

From Hon. C. L. Flint, of Boston, 200 volumes of agricultural books, presented to the Sophomore class.

From Dr. W. P. Jones, of Nashville, Tenn., 1 large plant of victoria regia, and 2 packages of seeds.

From the Publishers,—"The Boston Cultivator" for 1868; "The Massachusetts Ploughman," 1869; "The New England Farmer," 1869; "The American Naturalist," 1869; "The Proceedings of the Essex Institute," 1868-9; "The Amherst Record," 1869; "The Chicago Weekly Journal," 1869; "The California Farmer," 1869; "The New England Homestead," 1869.

From Hon. Wm. B. Washburn, of Greenfield, 10 volumes Congressional Documents.

From Clinton Cowles, Esq., of Amherst, 1 large fig-tree.

From Hon. Horace Capron, of Washington, D. C., several varieties of seeds, and the bi-monthly and annual Reports of the Department of Agriculture.

From Hon. Henry Barnard, of Washington, D. C., 1 volume, Report of Department of Education.

From President T. C. Abbott, of Lansing, Mich., 2 volumes, Report of Michigan Agricultural College and Board of Agriculture.

From Ames Plow Company, Boston, 1 plow.

From Collins Manufacturing Company, of Collinsville, Conn., 1 cast-steel plow.

From Hon. D. Waldo Lincoln, of Worcester, 1 volume, Allen's Victoria Regia.

From Hon. R. B. Hubbard, of Amherst, specimens of minerals from silver and quicksilver mines of California.

FINANCIAL STATEMENT FOR JANUARY 1ST, 1869.

Real Estate.

The College Farm contains 383½ acres, and cost, exclusive of buildings, ...	$37,000 00	
The Quarry in Pelham, cost	500 00	
		$37,500 00

Buildings.

South College, of brick, 100 × 50 feet, four stories, with cases for books and cabinet specimens, desks and chairs for public rooms, stoves, well, out-buildings and architect's bill, cost, .	$36,280 00	
Chemical Laboratory, of wood, 57 × 46 feet, two stories, with bell, cost	10,360 00	
South Boarding-House, of wood, with dining hall 50 × 18 feet, with furniture, cost, . . .	8,180 00	
Botanic Museum, of wood, 45 × 31 feet, two stories, with office and lecture room of president, with cases and furniture, cost	5,180 00	
Durfee Plant-Houses, with water, heating apparatus and shelving, cost	12,000 00	
Three Dwelling-Houses and four Barns, bought with the farm, with repairs, cost, ...	9,000 00	
North Boarding-House, of wood, with furniture, cost	8,000 00	
North College, of brick, 100 × 50 feet, four stories, with basement, with grading, architect's bill, gas-pipe, lightning-rods and stoves, . .	36,000 00	
		125,000 00
Total real estate, ...		$162,500 00

FARM INVENTORY.

Live Stock.

2 pairs of oxen, ...	$700 00	
4 cows, ...	240 00	
14 two year olds, ...	980 00	
3 yearlings, ...	150 00	
1 yearling bull, ...	75 00	
32 sheep, ...	500 00	
7 swine, ...	75 00	
5 horses, ...	1,300 00	
Total value of stock, ...		$4,020 00

Implements and Vehicles.

2 two-horse wagons,	$350 00	
2 ox carts,	240 00	
2 horse carts,	100 00	
1 one-horse farm wagon,	55 00	
1 two-horse sled,	70 00	
1 express sled,	70 00	
1 two-horse traverse sleigh,	50 00	
2 sets double harnesses,	125 00	
2 horse cart harnesses,	60 00	
2 single harnesses,	60 00	
8 plows,	100 00	
2 harrows,	25 00	
1 roller,	20 00	
1 seed planter,	15 00	
1 hay tedder,	65 00	
2 mowing machines,	200 00	
2 horse rakes,	50 00	
1 fanning mill,	25 00	
20 grain bags,	12 00	
1 corn sheller,	18 00	
2 cultivators,	18 00	
2 wheelbarrows,	14 00	
2 dirt scrapers,	14 00	
2 cutting machines,	18 00	
Small hand tools,	300 00	
Total value of implements and vehicles,		$2,074 00

Farm Produce on Hand.

125 tons hay,	$1,500 00	
8 tons straw,	80 00	
20 tons corn fodder,	120 00	
1,000 bushels corn,	1,000 00	
50 bushels rye,	75 00	
250 bushels oats,	150 00	
150 bushels potatoes,	100 00	
Other roots,	50 00	
Total value of farm produce on hand,		3,075 00

Total value of stock, tools, produce, &c., in charge of the Superintendent, ... $9,169 00

FUND FOR MAINTENANCE OF COLLEGE IN CHARGE OF THE STATE TREASURER.

The total amount received from the sale of the 360,000 acres of land given to Massachusetts, for the endowment of one or more colleges for the promotion of education in agriculture and the mechanic arts, is $236,307 40

Of this amount, in accordance with the Act of Congress, was expended for a farm, ... 29,778 40

The investments of the fund made by the State Treasurer are as follows:—

United States bonds, 5-20's, interest 6 per cent. gold,	$50,500 00
" " " 10-40's, " 5 " "	30,000 00
Massachusetts bonds, 5 per cent. gold,	24,000 00
" " 6 per cent. currency,	3,000 00
City of Salem bonds, 6 " "	55,000 00
City of Lynn bonds, 6 " "	25,000 00
Town of Milford bonds, 6 " "	14,200 00
Par value of bonds,	$201,700 00
Cash uninvested,	5,724 65
Total fund,	$207,424 65
Annual income of fund at 6 per cent.,	$12,445 48

Two-thirds of this is to be paid to the treasurer of the College, and one-third to the treasurer of the Institute of Technology.

Income of College from fund,	$8,296 99
By the conditions of the gift none of the income of the fund derived from the sale of land scrip can be used for the erection or repair of buildings.	
The Hills Fund of $10,000 for the maintenance of the Botanic Garden is in charge of the College treasurer, and at present yields an income of	500 00
Total income from funds,	$8,796 99

To this sum should be added the receipts of tuition and room rent, amounting to $51 per annum for each scholar, and the receipts from the sale of the products of the farm and garden.

Cash Receipts.

From sale of land scrip,	$168,061 50
town of Amherst,	75,000 00
appropriations of Legislature,	70,000 00
L. M. and H. F. Hills,	10,000 00
Dr. Nathan Durfee,	10,000 00
Total,	$333,061 50
Total indebtedness of College,	$23,369 42
Total cash on hand,	17,254 80

DR. MASSACHUSETTS AGRICULTURAL COLLEGE, *in account with* NATHAN DURFEE, *Treasurer.* CR.

1868.		
Jan'y 1,	To balance,	$4,485 83
6,	income of Hills fund,	500 00
June 8,	appropriation of 1868,	50,000 00
8,	balance from town of Amherst,	14,843 33
8,	income of State fund,	8,908 10
	term bill account,	7,566 04
	farm produce sold,	2,204 16
	plants sold,	107 28
	books sold,	54 83
Nov. 13,	cash on note of treasurer,	11,000 00
		$99,669 57

1868.	By building fund account,	$45,610 75
	contingent fund account,	5,986 52
	farm account, live stock and implements,	3,467 71
	bills payable, paid note at Amherst Bank,	2,000 00
	bills payable, paid on note to L. D. Cowles,	4,000 00
	interest account,	365 57
	expense account, assistant treasurer's office,	44 90
	Hills fund, paid for plants, &c.,	450 92
	salary account,	5,250 00
	term bill account, books and labor of students,	1,394 83
	board account, board of students,	4,447 36
	F. A. Lord, balance on contract for plant-house,	5,741 40
	personal accounts,	3,654 81
	Balance cash on hand,	17,254 80
		$99,669 57

BUILDING FUND.

1868.		
Jan'y 30,	To balance account, 1867, paid,	$5,586 18
	new dormitory, as per contract,	33,750 00
	new boarding-house,	5,621 84
	moving and repairing barns,	2,338 10
	repairs of buildings,	3,900 00
		$51,196 12

1868.		
June 1,	By appropriation from the legislature,	$50,000 00
	balance paid from general fund,	1,196 12
		$51,196 12

CONTINGENT FUND.

1868. Jan'y 30,	To expenses trustees,	$450 00	1868. Jan'y 30,	By amount from state treasurer to remove cabinet,	$528 39
	Mrs. T. D. Smith, board account,	227 61		sundry amounts,	43 07
	paid indebtedness, 1867,	2,162 02		term bill account, coal sold to students, spring term,	209 68
	farm account, workmen,	100 00		balance paid from general fund,	9,274 90
	students' labor account, for labor about colleges and green-house,	1,129 79			
	amount paid for furniture, table cutlery and crockery and kitchen furniture; also, furniture for recitation rooms and botanic museum,	1,310 00			
	bricks for boarding-house and cisterns,	330 00			
	coal for colleges and recitation rooms,	1,164 00			
	labor of men, grading, &c., with services of gardener,	881 52			
	architect's bill,	670 00			
	express and freight bills,	203 00			
	printing, advertising, stationery and stamps,	453 00			
	blacksmiths' bills,	125 00			
	plant-house expenses, pots, &c.,	180 00			
	insurance,	300 00			
	painters' bills,	370 00			
		$10,056 04			$10,056 04

Respectfully submitted,

NATHAN DURFEE,
Treasurer Massachusetts Agricultural College.

I have examined the Treasurer's accounts and find them correctly stated and accompanied by the proper vouchers.

D. WALDO LINCOLN, *Auditor.*

BOSTON, January 29, 1869.

CATALOGUE OF PLANTS IN DURFEE PLANT-HOUSE, 1868.

Abies Menziesi.
Abutilon Duc de Malakoff.
" insigne.
" striatum.
" Mesopotamicum.
Acacia armata.
" cultriformis.
" homalophylla.
" Julibrissin.
" Latrobei.
" leiophylla.
" leptophylla.
" lophantha.
" pubescens.
" spectabilis.
" trinervata.
" vestita.
Acanthus mollis.
" spinosus.
Achyranthes auro reticulata.
" Verschaffelti.
Achimenes in var.
Adelaster albo venatus.
Adhatoda cydoniæfolia.
Adiantum cuneatum.
" formosum.
" reniforme.
" setulosum.
" trapeziforme.
Ærides odoratum.
Æschynanthus grandiflorus.
" zebrinus.
Agapanthus umbellatus.
" " variegatus.
Agave Americana.
" " variegata.
Ageratum Mexicanum variegatum.
Aira cœrulea variegata.
Akebia quinata.
Allamanda grandiflora.
Allamanda neriifolia.
" Schotti.
Alocasia albo-violacea.
" macrorhiza variegata.
" metallica.
Alsophila australis.
Alternanthera amœna.
" spathulata.
" speciosa.
Aloe depressa.
" minor.
" Perdix.
" socotrina.
" spiralis.
" virens.
Aloysia citriodora.
Amaryllis Belladonna.
" Johnsoni.
Ananassa sativa.
" " variegata.
Anœctochilus argenteus.
Aphelandra aurantiaca.
" Leopoldi.
Aralia palmata.
" papyrifera.
" reticulata.
" Sieboldti.
Araucaria imbricata.
Ardisia crenulata.
" undulata.
Aristolochia altissima.
" Bonplandi.
" Sipho.
Arundo Donax variegata.
Asclepias curassavica alba.
Aspidistra elatior variegata.
Aspidium cristatum.
" falcatum.
Asplenium auritum.
" bulbiferum.

Asplenium falcatum.
" Filix-fœmina var. molle.
" Nidus-avis.
" viviparum.
Astilbe Japonica.
" " auro reticulata.
Atropa Belladonna.
Aucuba Japonica.
Azalea Indica, in 15 varieties.
Bambusa Fortuni variegata.
Banksia integrifolia.
Begonia, in 20 varieties.
Bellis perennis.
Bignonia Capensis.
" jasminoides.
" radicans.
" Rollinsoni.
Billbergia thyrsoidea.
" zebrina.
Blechnum australe.
" Brasiliense.
Bletia Tankervilliæ.
Bœhmeria argentea.
Bonapartea juncea.
Bougainvillea aurantiaca.
" spectabilis.
Bouvardia grandiflora.
" leiantha.
" triphylla.
Brexia spinosa.
Broughtonia sanguinea.
Brugmansia suaveolens.
Burchellia Capensis.
Caladium, in 10 varieties.
Calanthes vestita.
Calathea zebrina.
Calceolaria, in variety.
Callitris cupressiformis.
Camellia, in 25 varieties.
" Japonica.
" reticulata.
" Sasanqua.
Campylobotrys refulgens.
Canna bicolor de Java.
" discolor.
Cantua bicolor.
Carmichælia australis.
Casuarina quadrivalvis.
Cattleya Loddigesi.
Centaurea candidissima.
" gymnocarpa.
Centradenia floribunda.
" grandifolia.
Cerastium tomentosum.
Cereus giganteus.
" grandiflorus.
" flagelliformis.
" Mac Donaldi.
" Peruvianus.
" serpentinus.
" speciosissimus.
" tetragonus.
" triangularis.
Ceropegia elegans.
Cestrum acuminatum.
" aurantiacum.
Chamærops humilis.
Chilanthes lendigera.
Chimaphila maculata.
Chorozema elegans.
Chrysanthemum, in 20 varieties.
Cinchona officinalis.
Cineraria, in variety.
" maritima.
Cinnamomum Camphora.
" Cassia.
" verum.
Cissus discolor.
" porphyrophyllus.
Cistus laurifolius.
Citrus Aurantium.
" " variegatum.
" Limonum.
Clematis viticella Sophia.
Clerodendron Thompsoni.
Clianthus Dampieri.
Clivea nobilis.
Coccoloba platyclada.
Cocos plumosa.
Cœlogyne cristata.
Coffea Arabica.
Coleus, in 6 varieties.
Colocasia esculenta.
Convolulus Cneorum.
" Mauritanicus.
Cordyline australis.

Cordyline indivisa.
Coronilla elegans variegata.
Cotyledon orbiculatum.
Crassula punctata.
Crinum amabile.
Crocus, in 6 varieties.
Croton pictum.
" auro pictum.
Cryptomeria Japonica.
Cuphea platycentra.
Cupressus thyoides fol. var.
Curculigo Sumatrana.
Cyanophyllum magnificum.
Cyathea arborea.
Cyclamen Europœum.
" Persicum.
Cycas revoluta.
Cymbidium Sinense.
Cyperus alternifolius variegatus.
Cypripedium barbatum.
" insigne.
Cyrtanthera magnifica.
Cyrtopodium Andersoni.
Cytisus racemosus.
Dammara australis.
Daphne Indica.
" odora variegata.
Daubentonia magnifica.
Dendrobium nobile.
Deutzia gracilis.
Dianella cœrulea.
Dianthus Sinensis.
Dieffenbachia seguina maculata.
Dioscoria discolor.
Diosma fragrans.
Diospyrus Ebenum.
Doodia caudata.
Doryanthes excelsa.
Dracœna Brasiliensis.
" Cooperi.
" ferrea.
" marginata.
" terminalis.
Echinocactus recurvus.
Echites argyrœa.
" picta.
Echiveria retusa.
" secunda.
Epacris delicatissima.
" Wilmoriana.
Epidendrum macrochilum.
Epiphyllum coccineum.
" crenatum.
" Hookeri.
" phyllanthoides.
" speciosum.
" truncatum.
Eranthemum pulchellum.
Erica arborea.
" gracilis.
Erythrina Crista-galli.
Eucalyptus globulus.
" Stewartiana.
" viminalis.
Eucharis Amazonica.
Eugenia myrtifolia.
Euonymus Japonicus variegatus.
" radicans auro medio-pictus.
Eupatorium fruticosum.
Euphorbia clava.
" jacquiniflora.
" lactea.
" splendens.
Eurya latifolia variegata.
Fabiana imbricata.
Farfugium grande.
Ficus Carica.
" Cooperi.
" elastica.
" ferruginea.
" Porteana.
" religiosa.
" repens.
Franciscea eximia.
Frenela Guinii.
Fuchsia, in 20 varieties.
" corymbiflora.
" microphylla.
Galega orientalis.
Gardenia angustifolia variegata.
" florida.
" radicans.
Gastonia palmata.
Geissomeria longiflora.
Gelsemium sempervirens.
Geranium, vide Pelargonium.

Gesnera cinnabarina.
" elongata.
" fulgens.
" longiflora.
Gloriosa Planti.
Goldfussia anisophylla.
Goodyera pubescens.
Gymnostachyum Verschaffelti.
Gynerium argenteum.
Habrothamnus elegans.
Hardenbergia ovata alba.
Hedera Helix.
" " variegata.
Hedychium Gardnerianum.
Heliconia Brasiliensis.
Heliotropium, in 8 varieties.
Heterocentrum roseum.
" " album.
Hibiscus Cooperi.
" Rosa-Sinensis.
" " " flore pleno.
" " " flavus.
" splendens.
Hoya bella.
" carnosa.
" " variegata.
" grandiflora.
Humea elegans.
Hydrangea Japonica.
" " variegata.
Hymenocallis rotata.
Illicium religiosum.
Impatiens Jerdoniæ.
Inga pulcherrima.
Ixora coccinea.
Jasminum officinale.
" Sambac flore pleno.
Juanulloa aurantiaca.
Justicia carnea.
Kennedya rubicunda.
Laelia acuminata.
Lagerstræmia Indica.
" Reginæ.
Lantana in variety.
Lapageria rosea.
Lasiandra argentea.
Latania Borbonica.
Lavendula Spica.
Leycesteria formosa.
Lilium auratum.
" Browni.
" Chalcedonicum.
" excelsum.
" lancifolium in vars.
" longiflorum.
" venustum.
Limnocharis Humboldti.
Linum trigynum.
Lobelia erinoides.
Lomaria procera.
Lonicera auro reticulata.
Lophospermum Hendersoni.
" scandens.
Lycaste Skinneri.
Lycopodium apodum.
" arboreum.
" atrovirens.
" cæsium.
" denticulatum.
" formosum.
" Wildenowi.
Lygodium palmatum.
" scandens.
Magnolia fuscata.
" glauca.
" grandiflora.
Mahernia odorata.
Malvaviscus mollis.
Mammillaria discolor.
" longimamma.
" pusilla.
" stellata aurea.
Mandevillea suaveolens.
Maranta fasciata.
" micans.
" pulchella.
" regalis.
" sanguinea.
" Van den Hecki.
" Verschaffelti.
" vittata.
" Warsewiczi.
Marsilea quadrifolia.
Maurandya Barclayana.
Maxillaria aromatica.
Medinilla erythrophylla.

Melastoma velutina.
Mesembryanthemum in variety.
" muricatum.
" spectabile.
Meyenia erecta.
" " variegata.
Mimosa sensitiva.
Musa Cavendishi.
" paradisiaca.
Myrsiphyllum angustifolium.
Myrtus communis.
Narcissus, in varieties.
Nematanthus longipes.
Nepenthes distillatoria.
Nerium Oleander album.
" " splendens flore [pleno.
" " variegatum.
Nicotiana glauca.
Nymphaea ceruloea.
Odontoglossum citrosmum.
Olea fragrans.
" ilicifolia.
" sativa.
Oncidium Papilio.
Opuntia Brasiliensis.
" decumana.
" flavicoma.
" horrida.
" humilis.
" Tuna.
" vulgaris.
Oxalis Bowiei.
Pancratium maritimum.
Panicum imbecile variegatum.
" plicatum.
Passiflora alba.
" cœrulea.
" edulis.
" princeps.
" quadrangularis.
Pandanus elegantissimus.
" Javanicus variegatus.
" utilis.
Pelargonium, in 50 varieties.
Pereskia aculeata.
" Bleo.
Periploca Græca.
Peristeria elata.
Petunia, in 12 varieties.
Phaius maculatus.
Phaseolus Caracalla.
Philodendron pertusum.
Phœnix dactylifera.
Phormium tenax.
Phlox decussata.
Phyllanthus falcatus.
Pilea microphylla.
Pinus edulis.
Piper nigrum.
Pitcairnea fulgens.
Pittosporum Tobira.
" " variegatum.
Platycerium alcicorne.
Pleroma elegans.
Plumbago Capensis.
" rosea.
Poa trivialis variegata.
Poinciana pulcherrima.
Poinsettia pulcherrima.
Polygala Dalmasiana.
Polypodium aureum.
Portulaca flore pleno in var.
Possoqueria longiflora.
Pothos argyrœa.
" macrophylla.
Primula prænitens.
" " fimbriata rosea.
" " " plena [alba.
Psidium Cattleyanum.
Pteris argyræa.
" Cretica albo-lineata.
" hastata.
" incisa.
" rotundifolia.
" semi-pinnata.
" tremula.
Punica Granatum flore pleno.
" nana.
Puya longifolia.
Pyrethrum Parthenium.
" " foliis auro [pictis.
Quisqualis Indica.
Rhapis flabelliformis.
Rhipsalis fascicularis.
" pachyptera.
" salicornoides.

Rhododendron arboreum.
" Gibsoni.
Rhopala Corcovadensis.
Rhyncospermum jasminoides.
Richardia Æthiopica.
Ricinus communis.
" sanguineus.
Rochea falcata.
Rogiera amœna.
Rondeletia speciosa.
" splendens.
Rosa, in 20 varieties.
Rubus rosæfolius coronarius.
Ruellia picta.
Ruscus Hypophyllum.
Russelia juncea.
Salvia fulgens variegata.
" patens.
" splendens.
Sanseviera Javanica.
" carnea variegata.
Santolina canescens.
Sarracenia purpurea.
Saxifraga sarmentosa.
" " tricolor.
Schizostylis coccinea.
Scilla campanulata.
Scolopendrium vulgare.
Sedum carneum variegatum.
" Sieboldti.
" Telephium rubrum.
Sempervivum arboreum.
Sequoia gigantea.
Serissa fœtida.
" " variegata.
Siphocampylus bicolor.
Solandra grandiflora.
Solanum capsicastrum.
" jasminoides.
" Pseudo-capsicum.
Sonerila margaritacea.
Stachys lanata.
Stanhopea tigrina.
Statice Halfordi.
Stephanotis floribunda.
Stevia serrata.
Strelitzia Reginæ.
Sutherlandia frutescens.
Swainsonia Osborni.
Tacsonia lævis.
Taxus baccata aurea.
Tecoma jasminoides.
Thea Bohea.
" viridis.
Thujopsis dolobrata.
Thymus Serpyllum variegatus.
Thyrsacanthus rutilans.
Tillandsia rosea.
" usneoides.
Tournefortia heliotropioides.
Tradescantia zebrina.
Tragium Anisum.
Tricosanthes colubrina.
Tricyrtus hirtus.
Tritoma Uvaria serotina.
Tropeolum Jarratti.
" minus.
Vanda teres.
Vanilla aromatica.
Verbena, in 25 varieties.
Viburnum Tinus.
Victoria regia.
Vinca major.
" " variegata.
Wigandia Caraccasana.
Wistaria Sinensis.
" " alba.
Yucca aloifolia.
" " variegata.
" gloriosa.
Zephyranthes Atamasco.
Zingiber officinale.

Species about, ...	650
Varieties "	250
Total about, ...	900

REGISTER OF METEOROLOGICAL OBSERVATIONS

For the year 1868:

TAKEN AT AMHERST, MASS.,

By Professor E. S. SNELL, LL. D.

Latitude 42° 22′ 17″. Longitude 72° 34″ 30′. Elevation above the Sea level, 267 feet.

REMARKS.

The following tables, containing the principal results of the observations made in 1868, are copied from the Meteorological Journal of Amherst College:—

The hours of observation are 7 A.M., 2 P.M., and 9 P.M., according to the system adopted by the Smithsonian Institution. The temperature is given in degrees and tenths.

The amount of cloudiness is expressed by a number indicating the tenths of the sky covered. The kinds of clouds are marked by abbreviations, thus, *Str.* stratus, that is, spread in sheets; *Cum.* cumulus, piled in heaps; *Cir.* cirrus, drawn out in fibres.

Intermediate kinds are, *Cu-str.* cumulo-stratus; *Cir-str.* cirro-stratus; *Cir-cum.* cirro-cumulus. *Nim.* nimbus, is any kind of cloud, when falling in rain, snow or hail. The numbers giving the force of wind, are on a scale from one, the slightest perceptible, to ten, a destructive tornado.

The height of the barometer is expressed in inches and decimals. Since mercury is lighter when warmer, the observed height is reduced to that which would exist, if the mercury were at the temperature of 32 degrees. The columns headed "force of vapor," express the weight of moisture in the air, by stating what decimal of an inch of mercury is sustained by it; and the columns of "humidity" show what per cent. of complete saturation exists at the temperature and the time when the observation is made.

The temperature of 1868 was 1.2 degrees below the average. January, February, April, May, October, November and December, were all in a greater or less degree colder than usual; September was at the general mean for that month, and the remaining months, March, June, July, and August were warmer than the mean.

In respect to cloudiness, the year had about 5 per cent. more than the average. May was excessively cloudy, and September much more so than common.

The other months had not far from the average amount of clouds, which is 50 or 51 per cent. of the sky. The amount of atmospheric pressure for the year, never varies much from the mean. In 1868 it was slightly greater than usual. February and October were marked by the greatest pressure, and May by the least, as indicated by the tables.

The amount of moisture in the air was greater than the general mean. July and August were especially noticeable for their excessive dampness.

The fall of water was greater than the annual mean by about four and a half inches. The rain-fall of May was large, and that of September was quite unusual. No month in the year was deficient in this respect.

The following statements in relation to the crops, made by Mr. Stockbridge, Superintendent of the College farm, are in a measure explained by the meteorological facts presented in the foregoing remarks.

In consequence of the character of the season, our cultivated crops were sown and planted later than usual.

Early potatoes were planted the second week in May. They did not germinate for a long time, and grew very slowly until the first of July, when they pushed forward rapidly and were in condition to dig, the first of August. The crop was medium in quantity and quality.

Field potatoes, were planted late, last week in May and first in June, and came up very slowly. The foliage did not fully develop until after the middle of July, and was infested with the slug in August, but continued to grow until late in Septemper, and ripened a fair crop.

Oats were sown about the 25th of April, were a long time in coming up, struggled hard to live, until the last week in June, then commenced growing rapidly, and continued to do so until the last week in July, when they fell, and both straw and grain were light.

Winter rye started slowly in April and May, did not tiller well, but grew up rapidly in June and early July with a large, stout straw, filled a long head well, and ripened a heavy grain.

Corn planted the last week in May sprouted and came up quickly, but did not grow fast until July, then pushed forward rapidly through July and August, and ripened well in September an excellent crop.

Grass started slowly in April and May, advanced rapidly in June, but did not on natural meadow send out shoots and leaves so abundantly as usual, but attained its ordinary height. The crop was medium, and where cut after the first of July was of good quality. The second growth hardly started at all until August, and was very light.

JANUARY, 1868.

Day of Month	THERMOMETER IN THE OPEN AIR. 7 A. M.	2 P. M.	9 P. M.	Mean.	RAIN AND SNOW. Time of begin'g of rain or snow.	Time of ending of rain or snow.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	CLOUDS. 7 A. M. Amount of cloudiness.	Kind of clouds.	2 P. M. Amount of cloudiness.	Kind of clouds.	9 P. M. Amount of cloudiness.	Kind of clouds.
1	24.5	37.0	33.0	31.5	Night.	Night.	1.073	3.0	10	Nim. .	10	Nim. .	10	Nim. .
2	36.5	39.0	34.0	36.5	–	–	–	–	10	Str. .	7	Str. .	8	Str. .
3	31.2	39.5	27.0	32.8	Night.	–	–	–	7	Str. .	3	Str. .	2	Str. .
4	27.3	34.0	20.0	27.1	–	Night.	0.303	2.5	10	Nim.	10	Nim. .	10	Nim. .
5	16.0	20.0	12.0	16.0	–	–	–	–	2	Str. .	–	–	–	–
6	15.0	26.9	12.7	18.2	–	–	–	–	–	–	1	Str. .	1	Str. .
7	4 0	26.0	25.7	18.6	–	–	–	–	–	Str. .	8	Str. .	8	Str. .
8	27.0	36.3	30.0	31.1	–	–	–	–	10	Str. .	8	Str. .	9	Str. .
9	25.0	22.0	10.0	19.0	–	–	–	–	9	Str. .	7	Str. .	2	Str. .
10	6.3	13.2	6.0	8.5	–	–	–	–	–	–	1	Str. .	3	Str. .
11	4.9	23.0	13.8	13.9	–	–	–	–	–	Str. .	1	Str. .	–	Str. .
12	8.7	12.5	8.7	10.0	–	–	–	–	–	Str. .	–	–	–	–
13	0.0	18.4	13.0	10.5	–	–	–	–	–	–	2	Str. .	–	–
14	8.0	23.0	18.0	16.3	Night.	–	–	–	–	–	9	Str. .	7	Str. .
15	13.0	19.9	14.6	15.6	–	9 A. M.	0.075	1.0	10	Nim. .	10	Nim. .	1	Str. .
16	7.0	27.3	12.0	15.4	–	–	–	–	5	Str. .	7	Str. .	–	–
17	0.0	22.1	11.5	11.2	–	–	–	–	2	Str. .	1	Str. .	–	–
18	15.0	24.6	16.0	18.5	–	–	–	–	–	–	2	Cu-str.	7	Str. .
19	3.8	25.0	14.5	14.4	–	–	–	–	–	–	1	Str. .	–	–
20	19.7	34.0	32.5	28.7	Night.	–	–	–	10	Str. .	9	Str. .	7	Str. .
21	29.0	27.4	27.0	27.8	–	Night.	0.790	8.0	10	Nim. .	10	Nim. .	10	Nim. .
22	14.9	28.8	12.0	18.6	–	–	–	–	–	–	–	–	–	–
23	9.8	30.0	36.5	25.4	10 A. M.	Night.	0.598	0.5	10	Str. .	10	Nim. .	10	Nim. .
24	31.3	34.2	28.0	31.2	–	–	–	–	1	Str. .	5	Str. .	9	Str. .
25	18.8	28.0	22.0	22.9	–	–	–	–	2	Str. .	4	Str. .	1	Str. .
26	20.0	24.8	18.0	20.9	1 P. M.	Night.	0.335	7.0	10	Str. .	10	Nim. .	10	Nim. .
27	16.3	24.0	21.0	20.4	Noon.	Night.	0.078	1.0	10	Str. .	10	Str. .	10	Nim. .
28	15.6	23.0	21.0	19.9	Night.	–		–	9	Str. .	8	Str. .	10	Str. .
29	20.0	25.8	24.5	23.4	–	5 A. M.	0.265	3.0	10	Nim. .	10	Nim. .	10	Nim. .
30	22.5	22.1	17.7	20.8	–	–	–	–	10	Str. .	1	Str. .	–	–
31	5.1	22.0	18.0	15.0	–	–	–	–	1	Str. .	1	Str. .	7	Str. .
	Mean, . . 20.21 Max., . . 39.5 Min., . . 0.0				Sums, . . . 3,517			26.0	Mean, ... 5.1					

JANUARY, 1868.—Continued.

Winds 7 A. M. Direction.	Force.	Winds 2 P. M. Direction.	Force.	Winds 9 P. M. Direction.	Force.	Barometer height reduced to freezing point. 7 A. M.	2 P. M.	9 P. M.	Mean.	Force or pressure of vapor, in inches. 7 A. M.	2 P. M.	9 P. M.	Relative humidity or fraction of saturation. 7 A. M.	2 P. M.	9 P. M.	Day of Month.
N.	2	N. E.	3	N.	1	29.803	29.241	29.009	29.351	.130	.197	.188	100	89	100	1
W.	2	W.	3	W.	1	29.161	29.252	29.336	29.250	.191	.163	.160	90	70	81	2
E.	1	N.W.	2	N.W.	1	29.432	29.487	29.555	29.491	.160	.167	.146	92	68	100	3
N.W.	2	N. E.	1	N. E.	2	29.433	29.352	29.467	29.417	.147	.182	.108	100	92	100	4
N.W.	2	N.W.	2	W.	2	29.770	29.801	29.858	29.810	.087	.083	.074	100	77	100	5
N.W.	3	N.W.	2	W.	1	29.841	29.767	29.810	29.806	.058	.081	.066	68	57	86	6
W.	1	N. E.	2	E.	1	29.773	29.730	29.698	29.734	.050	.096	.117	100	71	88	7
N.	1	W.	1	N.W.	1	29.635	29.535	29.471	29.547	.122	.101	.116	85	47	72	8
N W.	1	N.W.	4	N.W.	5	29.346	29.303	29.469	29.373	.123	.090	.068	93	78	100	9
N.W.	3	W.	4	S.	1	29.560	29.578	29.598	29.579	.057	.069	.056	100	90	100	10
S. E.	2	S. W.	3	S.	1	29.568	29.480	29.532	29.527	.054	.091	.078	100	76	100	11
N.W.	5	W.	3	W.	2	29.710	29.801	29.861	29.791	.057	.060	.062	88	80	100	12
N.W.	1	N.W.	4	N.W.	3	29.948	29.447	30.063	29.819	.042	.082	.056	100	84	73	13
N.W.	2	N. E.	1	N.W.	1	30.153	30.106	30.052	30.104	.061	.104	.089	100	89	94	14
N E.	2	W.	1	S.W.	1	29.839	29.702	29.670	29.737	.077	.104	.081	100	100	100	15
N.W.	2	N.W.	3	N.	2	29.589	29.501	29.596	29.562	.058	.127	.071	100	88	100	16
W.	1	S.W.	3	S.	2	29.530	29.506	29.603	29.546	.041	.099	.069	100	86	100	17
N.W.	2	W.	2	S. E.	2	29.711	29.759	29.860	29.777	.085	.106	.088	100	87	100	18
N.W.	1	S. E.	2	E.	1	30.029	30.074	30.078	30.060	.050	.113	.082	100	87	100	19
S. E.	3	S. E.	2	E.	1	29.946	29.804	29.735	29.662	.105	.186	.181	100	97	100	20
N. E.	3	N.	3	N.	4	29.420	29.223	29.504	29.382	.159	.147	.147	100	100	100	21
N.W.	1	N.W.	2	S. E.	1	29.953	30.116	30.200	30.089	.084	.117	.073	100	76	100	22
S. E.	1	N.W.	2	N.W.	1	30.127	29.727	29.509	29.788	.066	.164	.212	100	100	100	23
N.W.	4	N.W.	3	N.W.	4	29.522	29.543	29.636	29.567	.129	.131	.120	74	68	79	24
N.W.	2	N.W.	3	W.	1	29.708	29.770	29.830	29.769	.098	.114	.104	100	75	92	25
S. E.	2	N.	1	N.	2	29.794	29.716	29.740	29.750	.105	.127	.098	100	100	100	26
N.	2	N.W.	2	N.	1	29.678	29.574	29.646	29.633	.090	.123	.112	100	100	100	27
N.W.	3	W.	2	W.	1	29.725	29.760	29.859	29.781	.087	.117	.112	100	97	100	28
N.	2	N.	2	N.	2	29 824	29.648	29.551	29.674	.107	.136	.131	100	100	100	29
N.W.	3	N.W.	4	N.W.	1	29.630	29.777	29.996	29.768	.111	.092	.090	93	78	96	30
S. E.	1	S.W.	2	W.	1	30.115	30.116	30.219	30.115	.053	.092	.090	100	81	96	31

Per cent. of Time and Force: N. W. & W. 61; S. W. & S. 7; S. E. & E. 11; N. E. & N. 21.	Mean, ... 29.686 Max., ... 30.219 Min., ... 29.009	Mean, . .106 Max., . .212 Min., . . .041	Mean, . . 91 Max., . . 100 Min., . . 47

FEBRUARY, 1868.

Day of Month.	Thermometer in the open air.				Rain and snow.				Clouds.					
									7 A. M.		2 P. M.		9 P. M.	
	7 A. M.	2 P. M.	9 P. M.	Mean.	Time of begin'g of rain or snow.	Time of ending of rain or snow.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Amount of cloudiness.	Kind of clouds.	Amount of cloudiness.	Kind of clouds.	Amount of cloudiness.	Kind of clouds.
1	5.7	27.5	14.9	16.0	–	–	–	–	–	–	–	–	–	–
2	7.0	30.2	26.0	17.7	–	–	–	–	1	Str.	5	Str.	3	Str.
3	5.0	7.0	-9.0	1.0	–	–	–	–	–	–	–	–	–	–
4	1.0	27.3	17.0	15.1	–	–	–	–	8	Str.	8	Str.	1	Str.
5	3.8	24.0	22.0	16.6	6 P. M.	–	–	–	–	Str.	1	Str.	10	Nim.
6	23.0	37.1	23.6	27.9	–	7 A. M.	0.290	3.0	10	Nim.	8	Str.	8	Str.
7	13.3	15.8	5.2	11.4	–	–	–	–	9	Str.	–	–	–	–
8	-18.3	10.0	7.3	-0.5	–	–	–	–	–	–	–	–	2	Cir.
9	19.0	38.0	36.3	31.1	6½ A. M.	Night.	0.333	1.0	10	Nim.	10	Nim.	10	Nim.
10	15.3	15.5	6.5	12.4	–	–	–	–	–	–	–	Str.	2	Str.
11	2.8	16.0	8.6	9.1	–	–	–	–	10	Str.	1	Str.	–	–
12	-9.2	23.0	16.0	9.9	–	–	–	–	–	–	–	–	2	Str.
13	13.8	36.0	31.0	26.9	–	–	–	–	7	Str.	9	Str.	3	Str.
14	10.8	20.0	14.5	15.1	–	–	–	–	1	Str.	1	Str.	2	Str.
15	21.2	39.0	33.0	31.1	–	–	–	–	10	Str.	9	Str.	10	Str.
16	28.0	30.7	17.0	25.2	–	–	–	–	9	Str.	1	Str.	–	–
17	3.5	32.0	31.0	22.2	2 P. M.	Night.	0.165	1.5	–	Str.	10	Nim.	10	Nim.
18	21.7	24.0	11.0	18.9	–	–	–	–	1	Str.	–	–	1	Str.
19	14.5	40.6	37.0	30.7	7 A. M.	8 A. M.	–	–	10	Nim.	7	Str.	–	–
20	21.0	42.8	37.0	33.6	–	–	–	–	1	Str.	2	Cir.	2	Str.
21	35.0	45.0	21.2	33.7	–	–	–	–	5	Str.	1	Cir.	2	Str.
22	6.0	13.0	4.0	7.7	–	–	–	–	3	Str.	1	Str.	–	–
23	-8.0	8.0	5.0	1.8	–	–	–	–	–	–	1	Str.	–	–
24	2.0	17.5	13.0	10.8	–	–	–	–	5	Str.	10	Str.	–	–
25	11.7	26.1	17.5	18.4	–	–		–	10	Str.	7	Str.	1	Str.
26	14.9	29.0	26.0	23.3	–	–	–	–	8	Str.	9	Str.	10	Str.
27	22.0	34.3	27.0	27.8	3 P. M.	8 P. M.	0.242	3.5	9	Str.	10	Nim.	10	Nim.
28	25.0	33.5	25.7	18.1	–	–	–	–	10	Str.	8	Str.	5	Str.
29	16.5	18.2	11.0	15.2	–	–	–	–	7	Str.	2	Str.	–	–
	Mean, . . 18.21 Max., . . 45.0 Min., . . -18.3				Sums, . . .		1.030	9.0	Mean, ...					0.0

FEBRUARY, 1868.—Continued.

Winds 7 A. M. Direction.	Force.	2 P. M. Direction.	Force.	9 P. M. Direction.	Force.	Barometer height reduced to freezing point. 7 A. M.	2 P. M.	9 P. M.	Mean.	Force or pressure of vapor, in inches. 7 A. M.	2 P. M.	9 P. M.	Relative humidity or fraction of saturation. 7 A. M.	2 P. M.	9 P. M.	Day of Month.
S. E.	3	S.	3	S.	2	30.359	30.309	30.239	30.302	.055	.099	.085	100	69	100	1
S. E.	2	S.	2	S. E.	1	30.010	29.861	29.798	29.890	.058	.142	.086	100	86	100	2
N.W.	3	N.W.	3	W.	1	30.033	30.221	30.323	30.192	.055	.058	.028	100	100	100	3
S.	3	S.W.	3	W.	2	30.107	29.942	30.063	30.037	.045	.101	.082	100	74	88	4
N.W.	1	W.	1	S.	1	30.115	29.980	29.734	29.944	.051	.105	.118	100	85	100	5
N.W.	3	S. E.	1	N.W.	4	29.363	29.132	29.310	29.268	.123	.192	.112	100	90	89	6
N.W.	4	N.W.	5	N.W.	2	29.456	29.697	29.987	29.713	.078	.083	.053	100	95	100	7
S. E.	1	N.W.	2	S. E.	2	30.197	30.188	30.108	30.164	.019	.059	.058	100	89	100	8
S. E.	2	S.W.	3	S.	2	29.748	29.404	29.237	29.463	.101	.225	.212	100	100	100	9
N.W.	4	N.W.	4	N.	2	29.710	29.939	30.064	29.904	.086	.066	.051	100	77	90	10
W.	2	S.	2	N.	1	30.045	29.963	30.071	30.030	.049	.088	.060	100	100	100	11
S. E.	1	S. E.	3	E.	1	30.135	30.045	30.088	30.089	.028	.098	.086	100	82	100	12
W.	2	S.	3	S.	3	29.989	29.763	29.693	29.815	.081	.138	.170	100	68	100	13
N.W.	2	N.	1	N. E.	1	29.937	29.998	30.012	29.982	.068	.088	.078	100	86	96	14
S. E.	3	S.W.	3	N.	1	29.855	29.705	29.707	29.756	.096	.169	.187	85	72	100	15
W.	3	N.	2	N.	1	29.849	29.897	29.936	29.894	.133	.112	.090	87	66	100	16
N.W.	1	S. E.	2	S. E.	1	29.833	29.587	39.461	29.627	.050	.155	.173	100	89	100	17
N.W.	4	N.W.	3	N.	1	29.617	29.645	29.692	29.651	.103	.086	.068	90	69	100	18
S. E.	2	S. E.	2	W.	2	29.527	29.476	29.608	29.404	.082	.195	.157	100	79	73	19
S. E.	1	S. E.	3	S. E.	4	29.684	29.588	29.505	29.592	.110	.175	.181	100	66	83	20
S. E.	1	W.	2	N.W.	4	29.430	29.487	29.547	29.547	.200	.186	.099	100	63	88	21
N.W.	4	N.W.	4	N.W.	3	29.932	30.004	30.150	30.029	.015	.060	.050	26	80	100	22
S.W.	1	N.W.	3	N.W.	2	30.278	30.331	30.474	30.361	.029	.062	.053	100	100	100	23
S. E.	1	N.	3	W.	1	30.526	30.416	30.387	30.433	.047	.070	.078	100	75	100	24
N.W.	2	N.W.	1	N.W.	2	30.330	30.244	30.219	30.264	.061	.051	.081	86	38	87	25
N.W.	2	N.W.	2	N.W.	1	30.206	30.128	30.040	30.125	.077	.129	.126	93	82	93	26
W.	1	S.W.	1	S.W.	1	29.844	29.630	29.457	29.644	.115	.168	.147	100	86	100	27
N.W.	1	N.W.	4	N.W.	4	29.155	29.136	29.177	29.169	.133	.134	.121	100	72	88	28
N.W.	3	N.W.	5	N.W.	3	29.294	29.391	29.596	29.427	.087	.079	.065	96	83	94	29

Winds	Barometer	Vapor	Humidity
Per cent. of Time and Force: N. W. & W. 57; S. W. & S. 17; S. E. & E. 19; N. E. & N. 7.	Mean, 29.852 Max., 30.526 Min., 29.132	Mean, .099 Max., .225 Min., .015	Mean, 90 Max., 100 Min., 26

MARCH, 1868.

Day of Month.	Thermometer in the open air. 7 A. M.	2 P. M.	9 P. M.	Mean.	Rain and snow. Time of begin'g of rain or snow.	Time of ending of rain or snow.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Clouds. 7 A. M. Amount of cloudiness.	Kind of clouds.	2 P. M. Amount of cloudiness.	Kind of clouds.	9 P. M. Amount of cloudiness.	Kind of clouds.
1	-7.3	22.1	18.0	10.9	–	–	–	–	–	–	7	Str.	10	Str.
2	13.8	12.0	10.0	11.9	Night.	7 P. M.	0.525	5.0	10	Nim.	10	Nim.	10	Str.
3	6.0	12.5	1.0	6.5	–	–	–	–	10	Str.	3	Str.	3	Str.
4	6.6	23.5	14.5	14.9	–	–	–	–	7	Str.	3	Str.	–	–
5	3.9	33.3	17 0	18.1	–	–	–	–	–	–	–	–	–	–
6	4.6	35.0	35.0	24.9	–	–	–	–	8	Str.	10	Str.	9	Str.
7	36.8	45.8	40.5	41.0	–	–	–	–	10	Str.	9	Str.	10	Str.
8	40.0	46.1	38.0	41.4	–	–	–	–	8	Str.	7	Str.	1	Str.
9	28.7	47.0	38.7	38.1	–	–	–	–	–	–	3	Cir. & Str.	3	Str.
10	38.0	48.0	43.0	43.0	*	–	–	–	8	Str.	3	Str.	10	Nim.
11	38.0	36.0	25.0	33.0	–	–	–	–	7	Str.	4	Cir.	–	–
12	17.9	38.7	33.9	30.2	6 P. M	–	–	–	1	Str.	8	Str.	10	Nim.
13	38.0	45.9	38.0	40.6	–	Noon.	1.273	–	10	Nim.	9	Str.	7	Str.
14	36.9	52.0	41.0	43.3	†	–	0.125	–	7	Str.	7	Str.	7	Str.
15	39.7	49.7	38.5	42.6	Night.	–	0.351	–	10	Fog & Str.	10	Str.	10	Fog,
16	37.0	46.5	43.0	42.2	Night.	–	0.205	–	10	Nim.	10	Str.	10	Nim.
17	39.7	46.0	50.0	45.2	Night.	–	0.225	–	10	Fog,	10	Fog,	10	Nim.
18	43.6	49.9	31.7	41.7	–	–	–	–	9	Str.	3	Cir. & Str.	2	Str.
19	26.8	43.3	32.1	34.0	–	–	–	–	–	–	–	Cir.	–	–
20	29.0	43.0	33.0	35.0	Night.	–	–	–	1	Str.	5	Cu-str.	10	Str.
21	28.0	34.3	31.5	31.3	–	6 P. M.	0.545	5.0	10	Nim.	10	Nim.	10	Nim.
22	29.0	36.0	30.0	31.7	–	–	–	–	5	Str.	–	Cu-str.	–	–
23	27.5	47.5	36.7	37.2	–	–	–	–	7	Str.	2	Cir.	–	–
24	31.0	40.4	30.2	33.9	–	–	–	–	–	–	–	Str.	–	–
25	26.0	40.0	29.6	31.9	–	–	–	–	3	Cir. & Str.	1	Cir.	1	Str.
26	29.7	41.2	32.0	34.3	–	–	–	–	1	Str.	1	Str.	–	–
27	32.1	56.3	39.9	42.8	–	–	–	–	2	Str.	2	Cir.	1	–
28	31.7	56.5	41.0	43.1	–	–	–	–	1	Str.	1	Str.	–	–
29	35.0	53.0	34.0	40.7	–	–	–	–	–	–	–	–	–	–
30	29.7	49.8	34.6	38.0	–	–	–	–	1	Str.	9	Str.	7	Str.
31	29.0	59.8	44.0	44.3	–	–	–	–	7	Str.	2	Str.	–	–
	Mean, . . 33.80 Max., . . 59.8 Min., . . -7.3				Sums, . . . 3.249			10.0	Mean, ... 4.8					

* Sprinkles. † Shower in night.

MARCH, 1868.—CONTINUED.

WINDS. 7 A. M. Direction.	Force.	2 P. M. Direction.	Force.	9 P. M. Direction.	Force.	BAROMETER HEIGHT REDUCED TO FREEZING POINT. 7 A. M.	2 P. M.	9 P. M.	Mean.	FORCE OR PRESSURE OF VAPOR, IN INCHES. 7 A. M.	2 P. M.	9 P. M.	RELATIVE HUMIDITY OR FRACTION OF SATURATION. 7 A. M.	2 P. M.	9 P. M.	Day of Month.
E.	1	S. E.	2	S. E.	1	29.732	29.675	29.608	29.672	.031	.086	.087	100	75	90	1
N. E.	3	N. E.	5	N.W.	4	29.261	29.008	29.163	29.144	.079	.073	.068	100	100	100	2
N.W.	3	N.W.	4	N.W.	2	29.425	29.480	29.602	29.502	.057	.067	.045	100	90	100	3
N.W.	2	N.W.	4	N.W.	1	29.655	29.726	29.948	29.776	.058	.098	.082	100	82	100	4
S. E.	1	S. E.	1	S.W.	1	30.143	30.193	30.318	30.218	.051	.134	.077	100	72	87	5
S. E.	1	S. E.	3	S.	4	30.360	30.132	30.127	30.206	.051	.169	.176	100	85	87	6
S.	3	S. E.	1	S. E.	1	29.996	29.957	29.941	29.965	.212	.263	.248	98	91	100	7
S. E.	3	S. E.	3	W.	1	29.837	29.815	30.006	29.886	.243	.277	.189	100	92	85	8
S. E.	1	S. E.	1	W.	1	30.127	30.077	30.073	30.092	.152	.208	.178	100	67	81	9
E.	1	S. E.	2	S.	1	29.970	29.773	29.852	29.865	.196	.234	.249	88	70	91	10
N.W.	2	N. E.	3	N.W.	1	30.055	30.249	30.349	30.218	.184	.098	.109	81	48	85	11
N.W.	2	S. E.	3	S. E.	2	30.285	30.087	29.869	30.080	.094	.182	.193	100	82	100	12
S. E.	2	S.	2	S.	1	29.485	29.428	29.457	29.457	.227	.282	.228	100	94	100	13
S. E.	1	N.W.	2	S. E.	1	29.523	29.585	29.631	29.580	.220	.245	.238	100	65	93	14
S. E.	2	S.	1	S.	1	29.645	29.673	29.747	29.688	.240	.328	.229	100	94	100	15
E.	2	E.	1	E.	1	29.795	29.750	29.717	29.754	.221	.311	.276	100	100	100	16
S. E.	1	S. E.	2	S.	2	29.656	29.568	29.597	29.607	.241	.304	.361	100	100	100	17
N.W.	4	N.W.	4	N.W.	2	29.598	29.645	29.873	29.715	.278	.205	.118	80	59	68	18
S. E.	1	N.W.	3	S. E.	2	29.950	29.933	29.976	29.953	.141	.119	.149	100	44	84	19
E.	1	S. E.	3	E.	3	29.901	29.765	29.629	29.765	.153	.181	.143	100	65	77	20
N. E.	4	N. E.	6	N.	5	29.199	28.953	29.023	29.058	.153	.171	.174	100	87	100	21
N.W.	5	N.W.	5	N.W.	1	29.220	29.373	29.596	29.396	.123	.151	.114	78	73	70	22
S. E.	2	N.	1	S.W.	1	29.614	29.463	29.455	29.511	.121	.144	.164	81	44	78	23
N.W.	1	N.	4	N.	1	29.489	29.649	29.866	29.668	.170	.110	.083	100	45	50	24
N.W.	1	N.W.	1	S. E.	1	29.962	29.927	29.909	29.933	.128	.109	.127	92	45	80	25
N.W.	3	E.	2	S. E.	1	29.977	29.914	29.871	29.921	.105	.080	.109	66	32	62	26
E.	2	S.W.	3	S. E.	2	29.714	29.568	29.560	29.614	.135	.103	.180	73	23	75	27
S.	1	S.W.	3	N. E.	3	29.611	29.593	29.768	29.657	.173	.126	.163	100	28	64	28
N.	3	N.W.	3	S. E.	3	29.938	29.955	30.076	29.990	.123	.109	.128	60	28	68	29
S. E.	2	S.W.	1	N.W.	1	30.108	29.967	29.897	29.991	.156	.162	.148	97	47	78	30
N.W.	1	N.W.	2	N.W.	1	29.720	29.574	29.536	29.610	.160	.204	.225	100	41	80	31

Per cent. of Time and Force: N. W. & W. 34; S. W. & S. 13; S. E. & E. 34; N. E. & N. 19.

Barometer: Mean, ... 29.758; Max., ... 30.360; Min., ... 28.953

Vapor: Mean, . . .162; Max., . . .361; Min., . . .031

Relative humidity: Mean, . . 82; Max., . . 100; Min., . . 23

APRIL, 1868.

Day of Month.	THERMOMETER IN THE OPEN AIR.				RAIN AND SNOW.				CLOUDS.					
									7 A. M.		2 P. M.		9 P. M.	
	7 A. M.	2 P. M.	9 P. M.	Mean.	Time of begin'g of rain or snow.	Time of ending of rain or snow.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Amount of cloudiness.	Kind of clouds.	Amount of cloudiness.	Kind of clouds.	Amount of cloudiness.	Kind of clouds.
1	33.3	67.5	50.3	50.4	*	–	–	–	–	–	–	–	3	Str. .
2	46.0	46.0	39.0	43.7	3½ P.M.†	–	0.432	–	9	Str.	10	Nim. .	4	Str. .
3	32.6	44.8	34.7	37.4	–	–	–	–	2	Str. .	–	Cu-str.	1	Str. .
4	34.4	40.3	32.9	35.9	9½ A. M.	Night.	0.158	1.5	8	Str. .	7	Str. .	2	Str. .
5	31.1	49.4	22.8	27.8	–	–	–	–	5	Nim. .	3	Cu-str.	1	Str. .
6	26.0	35.0	27.0	22.3	Night.	–	–	–	4	Str. .	2	Cu-str.	1	Str. .
7	32.8	33.7	32.0	32.8	–	9 P. M.	1.374	6.0	10	Nim. .	10	Nim. .	10	Nim. .
8	33.8	39.0	26.1	33.0	‡	–	–	–	2	Str. .	3	Cu-str.	–	–
9	23.2	32.0	24.0	26.4	–	–	–	–	–	Str. .	1	Str. .	–	–
10	23.0	28.4	27.0	26.1	8½ A. M.	10½ P. M.	0.626	7.5	10	Str. .	10	Nim. .	10	Nim. .
11	29.0	43.4	38.2	36.9	–	–	–	–	8	Str. .	1	Str. .	10	Str. .
12	40.3	33.8	29.7	34.6	–	–	–	–	9	Str. .	9	Str. .	9	Str. .
13	25.2	36.0	29.7	30.3	–	–	–	–	–	Str. .	–	–	–	–
14	26.8	50.1	36.2	37.7	7 P. M.	Night.	0.092	–	–	–	3	Str. .	10	Nim. .
15	42.0	61.7	57.0	53.6	–	–	–	–	10	Str. .	9	Str. .	10	Str. .
16	53.8	57.9	60.0	57.2	§	Night.	0.205	–	10	Str. .	10	Nim. .	10	Nim. .
17	55.0	64.2	52.0	57.1	–	–	–	–	10	Str. .	8	Str. .	2	Str. .
18	45.5	44.0	38.7	42.7	–	–	–	–	7	Str. .	8	Str. .	3	Str. .
19	40.4	60.9	48.0	49.8	–	–	–	–	–	–	5	Cir. .	10	Str. .
20	43.0	43.3	44.0	43.4	7 A. M.	Night.	0.965	–	10	Nim. .	10	Nim. .	10	Nim. .
21	46.5	60.0	47.8	51.4	–	–	–	–	5	Str. .	7	Cu-str.	2	Str. .
22	46.4	64.0	48.5	53.0	–	–	–	–	8	Fog & Str. .	–	–	1	Str. .
23	48.8	54.3	33.0	45.4	‖	–	–	–	2	Str. .	9	Str. .	–	–
24	33.0	56.5	42.0	43.8	–	–	–	–	–	Str. .	1	Cir. .	2	Str. .
25	39.0	44.8	39.8	41.2	7 A. M.	Noon.	0.171	1.0	10	Nim. .	10	Str. .	6	Str. .
26	37.0	58.0	40.5	45.2	–	–	–	–	3	Fog, .	7	Cu-str.	–	–
27	33.8	49.0	38.8	40.5	¶	–	–	–	10	Nim. .	10	Str. .	5	Str. .
28	39.0	55.9	45.8	46.9	–	–	–	–	–	–	–	–	–	–
29	39.0	62.5	48.3	49.9	–	–	–	–	5	Str. .	6	Str. .	10	Nim. .
30	42.8	64.0	59.8	55.5	3 P. M.†	–	0.247	–	10	Nim. .	1	Cu-str.	8	Nim. .
	Mean, . . . 41.96 Max., . . 67.5 Min., . . 23.0				Sums, . . .		4.270	16.0	Mean, ...					5.2

* Sprinkle in night. † Thunder shower. ‡ Snow squalls.
§ Shower. ‖ Squalls. ¶ Flakes of snow.

APRIL, 1868.—Continued.

Winds. 7 A. M. Direction.	Force.	2 P. M. Direction.	Force.	9 P. M. Direction.	Force.	Barometer height reduced to freezing point. 7 A. M.	2 P. M.	9 P. M.	Mean.	Force or pressure of vapor, in inches. 7 A. M.	2 P. M.	9 P. M.	Relative humidity or fraction of saturation. 7 A. M.	2 P. M.	9 P. M.	Day of Month.
S. E.	2	S.W.	2	S. E.	1	29.493	29.335	29.355	29.394	.187	.163	.258	100	25	71	1
E.	1	N.W.	1	W.	3	29.359	29.260	29.390	29.336	.296	.296	.193	97	97	81	2
N.W.	4	N.W.	3	S. E.	1	29.597	29.584	29.543	29.575	.162	.160	.143	89	54	73	3
S.W.	1	W.	3	W.	3	29.399	29.315	29.381	26.365	.191	.155	.131	98	62	71	4
W.	1	N.W.	6	N.W.	5	29.296	29.474	29.704	29.491	153	.100	.090	89	63	75	5
S.W.	3	N.W.	5	E.	1	29.785	29.773	29.867	29.808	.111	.088	.115	81	46	86	6
S. E.	2	N. E.	2	N. E.	3	29.696	29.312	28.755	29.253	.183	.184	.178	100	95	100	7
N.W.	4	N.W.	3	N.W.	2	29.114	29.250	29.837	29.300	.147	.141	.102	77	61	73	8
N.W.	3	N.W.	3	N.W.	1	29.914	30.001	30.077	29.997	.100	.100	.105	82	57	85	9
N.	2	E.	1	N. E.	1	30.059	29.886	29.723	29.889	.112	.151	.147	93	100	100	10
S. E.	1	N.	2	S.	3	29.629	29.594	29.494	29.572	.155	.173	.168	100	64	74	11
S.	2	W.	3	N.	3	29.318	29.601	29.740	29.553	.225	.118	.102	91	62	63	12
N.W.	1	N.W.	3	N.W.	1	29.941	29.981	30.069	29.997	.094	.099	.105	73	47	66	13
N.W.	2	S.	3	S.	3	30.138	30.000	29.915	30.018	.126	.175	.208	90	50	100	14
S.	3	S.W.	1	S.	4	29.701	29.614	29.593	29.636	.266	.464	.453	100	86	98	15
S.W.	3	S.W.	2	S.	4	29.560	29.502	29.451	29.504	.411	.474	.499	100	100	97	16
S. E.	2	S.W.	3	W.	1	29.506	29.448	29.548	29.501	.428	.285	.311	100	48	81	17
N.W.	2	N.W.	5	N.W.	4	29.641	29.789	29.957	29.796	.221	.165	.145	72	57	62	18
S. E.	1	S.W.	3	S.	2	30.124	30.076	30.082	30.094	.181	.242	.323	71	46	100	19
S. E.	2	N.	2	N.	2	29.984	29.796	29.717	29.832	.186	.278	.289	67	100	100	20
W.	2	S.W.	1	S.	3	29.786	29.747	29.788	29.774	.311	.347	.323	100	67	100	21
S. E.	1	N.W.	3	W.	2	29.845	29.850	29.895	29.863	.312	.160	.184	100	28	56	22
S. E.	3	W.	4	N.W.	5	29.780	29.697	30.053	29.843	.281	.244	.132	82	60	71	23
S. E.	2	S.W.	2	S.	3	30.193	30.085	30.088	30.122	.146	.186	.164	78	42	63	24
S. E.	3	S. E.	1	W.	1	30.018	29.936	29.925	29.960	.180	.268	.243	77	94	100	25
S. E.	2	W.	5	N.W.	1	29.933	29.825	29.984	29.914	.221	.145	.135	100	32	55	26
N.W.	1	N.W.	2	N.	2	30.001	29.844	29.928	29.924	.175	.222	.223	92	64	95	27
N.W.	2	N.	1	S.W.	3	29.990	29.954	29.996	29.980	.221	.210	.233	95	50	77	28
N.W.	1	S. E.	3	N. E.	2	30.045	29.922	29.773	29.913	.217	.194	.186	92	35	56	29
N.	1	S.W.	3	W.	3	29.495	29.359	29.424	29.426	.272	.457	.379	100	81	73	30

Winds	Barometer	Vapor	Humidity
Per cent. of Time and Force: N. W. & W. 48; S. W. & S. 27; S. E. & E. 14; N. E. & N. 11.	Mean, ... 29.721 Max., ... 30.193 Min., ... 28.755	Mean, . . .211 Max., . . .499 Min., . . .088	Mean, . . 77 Max., . . 100 Min., . . 25

MAY, 1868.

Day of Month.	Thermometer in the open air. 7 A. M.	2 P. M.	9 P. M.	Mean.	Rain and snow. Time of begin'g of rain or snow.	Time of ending of rain or snow.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Clouds. 7 A. M. Amount of cloudiness.	Kind of clouds.	2 P. M. Amount of cloudiness.	Kind of clouds.	9 P. M. Amount of cloudiness.	Kind of clouds.
1	44.6	55.5	45.9	48.6	–	–	–	–	2	Str.	1	Cu-str.	–	–
2	42.2	41.0	41.3	41.5	6 A. M.	3 P. M.	0.982	–	10	Nim.	10	Nim.	7	Str.
3	43.0	59.8	47.2	50.0	–	–	–	–	8	Str.	2	Str.	–	–
4	44.3	66.8	50.0	53.7	–	–	–	–	2	Cir.	3	Cu-str.	–	Str.
5	46.3	66.2	54.7	55.7	Night.*	–	0.326	–	5	Str.	8	Cu-str.	10	Str.
6	48.7	63.9	50.8	54.5	P. M.†	–	0.065	–	10	Str.	9	Str.	1	Str.
7	45.0	47.6	43.3	45.3	Night.	–	–	–	8	Str.	9	Str.	10	Str.
8	36.0	49.3	42.0	42.4	–	9 A. M.	0.625	–	10	Nim.	8	Cu-str.	–	–
9	46.0	58.0	48.0	50.7	–	–	–	–	–	Str.	4	Cum.	–	–
10	47.5	62.8	49.3	53.2	–	–	–	–	3	Cir.	7	Cu-str.	10	Str.
11	46.7	56.0	47.8	50.2	–	–	–	–	9	Str.	8	Str.	–	–
12	45 0	67.0	48.7	53.6	–	–	–	–	–	–	4	Cu-str.	–	–
13	50.0	59.5	54.8	54.8	2½ P. M.	–	–	–	6	Str.	9	Str.	10	Nim.
14	57.0	72.3	57.0	62.1	–	11 A. M.	1.362	–	10	Nim.	7	Str.	–	–
15	50.5	62.4	55.0	56.0	P. M.*	–	0.275	–	9	Fog & Str.	10	Nim.	10	Str.
16	51.1	73.8	60.7	61.8	–	–	–	–	8	Str.	6	Cu-str.	5	Str.
17	56.9	73.0	59.7	63.2	Night.	–	–	–	8	Str.	7	Cu-str.	10	Str.
18	56.7	56.0	52.0	54.9	–	6 P. M.	0.725	–	10	Nim.	10	Nim.	10	Str.
19	49.9	57.3	52.5	53 0	–	–	–	–	8	Str.	9	Str.	10	Str.
20	50.0	59.0	56.0	53.3	6 P. M.	–	–	–	9	Str.	9	Str	10	Nim.
21	52.0	56.9	55.0	54.6	–	Night.	1.534	–	10	Nim.	10	Nim.	10	Nim.
22	54.9	62.0	57.0	58.0	†	–	–	–	8	Str.	10	Nim.	10	–
23	52.0	56.9	51.0	53.3	10 A. M.	–	–	–	9	Str.	10	Nim.	10	Nim.
24	49.4	61.9	54.5	55.3	–	11 A. M.	1.468	–	10	Nim.	10	Str.	10	Str.
25	53.9	64.6	60.0	59.5	†	–	–	–	10	Str.	10	Nim.	10	Nim.
26	56.8	64.0	60.0	60.3	†	–	0.106	–	10	Nim.	9	Str.	9	Str.
27	59.7	75.0	61.2	65.3	–	–	–	–	9	Str.	2	Cum.	–	–
28	54.5	72.1	62.0	62.9	–	–	–	–	10	Str.	3	Str.	6	Str.
29	60.3	68.9	63.0	64.1	2 P. M.	Night.	0.395	–	10	Str.	9	Nim.	10	Nim.
30	57.7	66.9	63.5	62.7	†	–	–	–	10	Str.	10	Nim.	8	Str.
31	61.8	68.6	58.0	62.8	–	–	–	–	2	Str.	5	Cu-str.	1	Str.
	Mean, 55.40 Max., 78.0 Min., 36.0				Sum,		7.863	–	Mean,					7.1

* Showers. † Sprinkles.

MAY, 1868.—CONTINUED.

WINDS. 7 A. M. Direction.	Force.	WINDS. 2 P. M. Direction.	Force.	WINDS. 9 P. M. Direction.	Force.	BAROMETER. Barometer height reduced to freezing point. 7 A. M.	2 P. M.	9 P. M.	Mean.	FORCE OR PRESSURE OF VAPOR, IN INCHES. 7 A. M.	2 P. M.	9 P. M.	RELATIVE HUMIDITY OR FRACTION OF SATURATION. 7 A. M.	2 P. M.	9 P. M.	Day of Month.
N.W.	4	N. E	4	N.	2	29.650	29.708	29.708	29.689	.212	.192	.179	73	44	61	1
N.	1	N.	1	E.	1	29.843	29.776	29.725	29.781	.262	.255	.257	98	100	100	2
N.	2	N.	3	N.W.	1	29.711	29.678	29.749	29.713	.273	.294	.220	98	59	69	3
S. E.	1	S.W.	2	S.	3	29.776	29.633	29.637	29.682	.289	.256	.248	100	39	69	4
N.W.	1	S.W.	4	S.W.	3	29.576	29.481	29.527	29.528	.299	.380	.274	96	61	66	5
N.W.	1	S.W.	3	W.	1	29.524	29.422	29.433	29.460	.315	.365	.334	93	63	92	6
N. E.	3	N. E.	2	N. E.	2	29.422	29.371	29.320	29.453	.216	.259	.266	72	80	96	7
N. E.	2	N.W.	4	W.	3	29.198	29.299	29.447	29.315	.212	.202	.190	100	58	74	8
W.	3	N.W.	4	N.W.	1	29.525	29.496	29.594	29.538	.193	.223	.220	64	46	68	9
E.	1	N.W.	2	N.	2	29.669	29.673	29.856	29.733	.249	.153	.292	77	28	84	10
W.	1	N. E.	3	N. E.	1	29.948	29.976	29.997	29.974	.253	.241	.233	80	54	71	11
N.W.	1	S. E.	2	S.	1	30.018	29.941	29.983	29.981	.231	.316	.236	78	49	70	12
E.	2	S. E.	5	N. E.	5	29.922	29.752	29.562	29 745	.237	.380	.425	66	76	99	13
N. E.	1	S. E.	3	S. E.	3	29.472	29.489	29.623	29.528	.463	.583	.380	100	82	83	14
N.W.	1	S. E.	3	S. E.	1	29.773	29.713	29.798	29.761	.364	.478	.405	99	87	94	15
N.W.	1	S.	1	S.	1	29.734	29.644	29.651	29.676	.374	.542	.482	100	66	93	16
S. E.	2	W.	3	S.	2	29.634	29.540	29.574	29.583	.445	.462	.436	97	59	87	17
E.	1	N. E.	1	N.W.	3	29.444	29.357	29.423	29.408	.450	.449	.362	99	100	95	18
N.	2	N. E.	1	S. E.	2	29.658	29.719	29.799	29.725	.345	.325	.373	96	70	96	19
N. E.	2	N. E.	3	N.	2	29.866	29.834	29.768	29.823	.307	.351	.374	85	73	100	20
N.	4	N. E.	3	N. E.	1	29.385	29.204	29.287	26.292	388	.447	.430	100	97	100	21
S. E.	2	S. E.	1	S.	1	29.443	29.523	29.651	29.539	.390	.427	.466	92	77	100	22
N. E.	3	N. E.	2	N. E.	3	29.717	29.699	29.649	29.688	.388	.435	.374	100	95	100	23
N.	3	E.	2	S. E.	1	29.468	29.431	29.506	29.468	.344	.467	.425	98	86	100	24
S. E.	1	E.	1	S. E.	1	29.537	29.560	29.626	29.574	.410	.517	.509	100	86	100	25
S. E.	1	E.	1	E.	3	29.706	29.708	29.704	29.706	.456	.479	.471	100	82	91	26
N.W.	2	W.	2	S. E.	3	29.698	29.579	29.580	29.619	.458	.558	.476	90	66	89	27
S. E.	2	S.W.	2	S.W.	2	29.594	29.545	29.591	29.577	.420	.599	.139	99	77	82	28
S. E.	1	S. E.	2	S. E.	4	29.628	29.598	29.565	29.597	.514	.696	.566	98	100	98	29
S. E.	1	S.	2	S. E.	1	29.566	29.543	29.569	29.599	.463	.590	.576	99	89	100	30
N.W.	3	N.W.	4	N.W.	1	29.611	29.588	29.673	29.624	.402	.421	.366	73	60	77	31

Winds	Barometer	Vapor	Humidity
Per cent. of Time and Force: N. W. & W. 24; N. E. & N. 34; S. E. & E. 28; S. W. & S. 14.	Mean, ... 29.624 Max., ... 29.997 Min., ... 29.204	Mean, . . .365 Max., . . .696 Min., . . .139	Mean, . . 83 Max., . . 100 Min., . . 28

JUNE, 1868.

Day of Month.	THERMOMETER IN THE OPEN AIR.				RAIN AND SNOW.				CLOUDS. 7 A. M.		CLOUDS. 2 P. M.		CLOUDS. 9 P. M.	
	7 A. M.	2 P. M.	9 P. M.	Mean.	Time of begin'g of rain or snow.	Time of ending of rain or snow.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Amount of cloudiness.	Kind of clouds.	Amount of cloudiness.	Kind of clouds.	Amount of cloudiness.	Kind of clouds.
1	57.0	70.0	60.7	62.6	–	–	–	–	–	Str.	5	Cu-str.	10	Str.
2	56.0	67.7	58.7	60.8	–	–	–	–	2	Cu-str.	4	Cu-str.	8	Str.
3	52.7	66.5	56.5	58.6	–	–	–	–	2	Cir.	3	Cum.	9	Str.
4	55.5	69.2	53.0	59.2	–	–	–	–	–	–	–	–	–	–
5	51.8	66.0	62.0	59.9	P. M.*	–	–	–	9	Str.	10	Str.	10	Nim.
6	66.0	76.5	68.0	70.2	Night.†	–	0.225	–	10	Str.	7	Str.	8	Str.
7	64.0	60.7	58.0	60.9	6 A. M.	8 P. M.	0.326	–	10	Nim.	10	Str.	10	Str.
8	57.8	68.0	63.2	64.3	–	–	–	–	8	Str.	5	Cu-str.	–	Str.
9	60.7	72.3	59.5	64.2	P. M.‡	–	0.203	–	10	Str.	7	Str.	2	Str.
10	63.0	69.5	57.0	63.2	12 M.	–	–	–	–	Cir.	1	Cu-str.	1	Str.
11	53.8	54.0	50.5	52.8	–	–	–	–	9	Str.	10	Nim.	10	Nim.
12	53.0	62.6	63.0	59.5	–	6 P. M.	0.863	–	10	Nim.	10	Nim.	9	Str.
13	60.3	78.9	69.2	69.5	–	–	–	–	2	Cir.	7	Str.	9	Str.
14	64.0	79.5	67.7	70.4	–	–	–	–	–	–	2	Cu-str.	2	Str.
15	63.0	81.9	68.0	73.0	–	–	–	–	–	–	4	Cir.	9	Str.
16	63.8	80.4	69.0	71.1	P. M.†	–	0.162	–	10	Nim.	7	Cu-str.	10	Str.
17	70.0	81.0	70.0	73.7	–	–	–	–	10	Str.	3	Cum.	–	–
18	65.0	80.8	69.0	71.6	–	–	–	–	10	Str.	2	Str.	1	Str.
19	65.8	82.8	73.5	73.9	–	–	–	–	10	Str.	1	Cum.	1	Str.
20	69.0	88.7	79.0	78.9	–	–	–	–	10	Str.	1	Cum.	7	Str.
21	70.0	71.0	62.0	67.7	9 A. M.	–	–	–	10	Str.	10	Nim.	10	Nim.
22	59.2	61.0	57.0	59.1	–	10 A. M.	0.662	–	10	Nim.	10	Str.	10	Str.
23	57.0	72.9	63.5	64.5	§	–	–	–	10	Nim.	3	Cum.	5	Str.
24	60.0	71.0	58.0	63.0	–	–	–	–	1	Str.	7	Str.	1	Str.
25	56.8	76.8	64.0	65.9	–	–	–	–	10	Fog.	2	Cum.	1	Str.
26	61.8	76.8	70.3	69.6	–	–	–	–	4	Cir.	7	Str.	5	Str.
27	65.0	85.1	69.5	73.2	–	–	–	–	–	–	–	–	1	Str.
28	63.5	77.0	67.5	69.3	–	–	–	–	1	Str.	–	Cum.	–	–
29	57.7	76.4	66.0	66.7	–	–	–	–	2	Cir.	2	Cum.	–	–
30	63.7	77.8	62.2	67.9	–	–	–	–	2	Cir.	2	Cir.	2	Str.
	Mean, . . 66.17 Max., . . 88.7 Min., . . 51.8				Sum, . . .		2.441	–	Mean, ... 5.1					

* Mist. † Thunder Shower. ‡ Sprinkles. § Mist in morning.

JUNE, 1868.—Continued.

Winds 7 A. M. Direction.	Force.	Winds 2 P. M. Direction.	Force.	Winds 9 P. M. Direction.	Force.	Barometer (height reduced to freezing point) 7 A. M.	2 P. M.	9 P. M.	Mean.	Force or Pressure of Vapor, in Inches 7 A. M.	2 P. M.	9 P. M.	Relative Humidity or Fraction of Saturation 7 A. M.	2 P. M.	9 P. M.	Day of Month.
S.	1	W.	3	S.W.	1	29.738	29.677	29.705	29.707	.385	.351	.385	84	49	74	1
N.W.	1	N.W.	2	N.W.	2	29.742	29.661	29.787	29.730	.349	.262	.276	81	40	57	2
N.W.	2	W.	2	S. E.	3	29.910	29.910	30.016	29.945	.308	.345	.336	79	54	75	3
S. E.	1	S. E.	1	S. E.	3	30.104	30.058	30.142	30.101	.352	.358	.324	82	51	84	4
N.W.	2	S. E.	2	S.	2	30.068	29.979	29.869	29.972	.318	.531	.556	84	85	100	5
S.W.	3	S.	4	S. E.	3	29.743	29.667	29.670	29.693	.634	.707	.601	99	80	89	6
N.W.	1	N.	3	E.	1	29.774	29.849	29.926	29.850	.596	.493	.444	100	94	92	7
N.W.	1	N.W.	2	S. E.	2	29.947	29.845	29.814	29.869	.475	.626	.545	100	77	95	8
S. E.	1	S.	2	N.W.	1	29.791	29.704	29.809	29.768	.524	.666	.494	100	86	99	9
N.	3	W.	2	S. E.	1	29.947	29.925	29.941	29.938	.367	.382	.428	93	54	94	10
N.W.	1	N.	2	N.	2	29.968	29.912	29.858	29.913	.408	.566	.361	100	95	99	11
N.	3	N.	1	N.W.	3	29.579	29.498	29.564	29.547	.403	.549	.526	100	99	91	12
W.	1	–	–	S. E.	1	29.803	29.746	29.806	29.795	.494	.609	.615	96	62	87	13
S. E.	1	S. E.	2	S. E.	2	29.907	29.859	29.875	29.880	.531	.732	.544	92	74	84	14
S. E.	1	S. E.	3	S. E.	3	29.911	29.893	29.773	29.859	.514	.715	.594	90	68	87	15
S. E.	1	S. E.	2	S. E.	2	29.715	29.630	29.660	29.668	.586	.838	.703	100	84	100	16
N.W.	1	E.	2	N.W.	1	29.668	29.624	29.634	29.642	.717	.746	.685	99	72	96	17
E.	1	S. E.	3	–	–	29.672	29.620	29.581	29.624	.613	.816	.674	99	80	96	18
S. E.	1	S. E.	1	S. E.	2	29.541	29.432	29.375	29.449	.624	.904	.804	100	83	99	19
S. E.	1	S.W.	3	–	–	29.378	29.333	29.389	29.367	.701	.680	.731	100	51	74	20
N.W.	1	E.	2	E.	2	29.462	29.534	29.621	29.539	.699	.685	.511	96	91	93	21
N. E.	1	E.	1	S. E.	2	29.627	29.635	29.648	29.637	.504	.483	.456	100	90	99	22
N.W.	1	N.W.	3	E.	1	29.630	29.624	29.720	29.658	.462	.415	.528	100	53	91	23
W.	1	W.	2	W.	1	29.808	29.810	29.883	29.834	.441	.442	.440	85	59	94	24
S. E.	1	S. E.	2	S.W.	1	29.990	29.918	29.896	29.935	.451	.550	.523	100	62	89	25
S. E.	1	S.W.	2	W.	1	29.830	29.700	29.652	29.727	.510	.662	.579	94	76	79	26
N. E.	1	N.W.	2	W.	1	29.567	29.482	29.495	29.515	.583	.551	.598	94	47	85	27
N.	1	N.	3	N.	1	29.586	29.607	29.691	29.628	.478	.583	.502	83	64	78	28
W.	1	S.W.	2	S. E.	3	29.836	29.834	29.889	29.853	.441	.544	.573	94	61	93	29
S. E.	2	S.	4	S.	3	29.968	29.909	29.956	29.944	.535	.629	.410	93	69	74	30

Per cent. of Time and Force:	Barometer	Force or Pressure of Vapor	Relative Humidity
N. W. & W. 00; S. W. & S. 00; S. E. & E. 00; N. E. & N. 00.	Mean, ... 29.753 Max., ... 30.142 Min., ... 29.333	Mean, . . .535 Max., . . .904 Min., . . .262	Mean, . . 84 Max., . . 100 Min., . . 40

JULY, 1868.

Day of Month.	Thermometer in the open air. 7 A. M.	2 P. M.	9 P. M.	Mean.	Rain and snow. Time of begin'g of rain or snow.	Time of ending of rain or snow.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Clouds. 7 A. M. Amount of cloudiness.	Kind of clouds.	2 P. M. Amount of cloudiness.	Kind of clouds.	9 P. M. Amount of cloudiness.	Kind of clouds.
1	65.0	74.2	67.8	69.0	–	–	–	–	8	Str. .	10	Str. .	3	Str. .
2	66.2	82.5	75.0	74.6	–	–	–	–	10	Str. .	1	Str. .	1	Str. .
3	70.5	89.0	74.5	78.0	–	–	–	–	10	Str. .	2	Cum. .	3	Str. .
4	71.9	89.8	79.5	79.7	–	–	–	–	–	Cir. .	3	Cum. .	–	–
5	77.3	93.2	77.7	82.7	–	–	–	–	–	Str. .	3	Cum. .	5	Str. .
6	72.0	78.0	61.3	70.4	–	–	–	–	1	Str. .	–	Smoke,	–	Smoke,
7	61.3	73.0	67.8	67.4	P. M.	9 P. M.	0.253	–	1	Str. .	9	Str. .	9	Str. .
8	69.0	80.5	71.8	73.8	–	–	–	–	10	Str. .	7	Cu-str.	5	Str. .
9	70.0	71.2	68.0	69.7	–	–	–	–	10	Str. .	10	Nim. .	10	Str. .
10	64.2	82.0	73.7	73.3	–	–	–	–	3	Cir. .	1	Cum. .	1	Str. .
11	68.5	89.0	77.8	78.4	–	–	–	–	10	Str. .	4	Cir. .	–	–
12	72.7	93.9	78.8	81.8	–	–	–	–	5	Str. .	5	Cir. & Str. .	1	Str. .
13	76.9	94.0	75.0	82.0	3 & 4 P. M.*	–	0.882	–	1	Cir. .	2	Str. .	8	Str. .
14	77.0	92.0	79.0	82.7	–	–	–	–	2	Str. .	2	Cum. .	2	Str. .
15	74.9	94.5	83.0	84.1	–	–	–	–	10	Str. .	2	Cum. .	9	Str. .
16	78.3	86.0	74.2	79.5	–	–	–	–	2	Str. .	3	Cum. .	1	Str. .
17	67.6	83.5	71.0	74.0	–	–	–	–	–	–	2	Cum. .	–	–
18	66.2	86.2	75.5	76.0	–	–	–	–	9	Str. .	–	–	1	Str. .
19	69.9	86.0	74.7	76.9	5 P. M.	8 P. M.	0.444	–	10	Str. .	9	Str. .	10	Nim. .
20	71.2	73.3	67.9	70.8	–	–	–	–	10	Str. .	10	Str. .	10	Str. .
21	66.0	77.0	69.7	70.9	–	–	–	–	10	Str. .	7	Str. .	10	Str. .
22	69.6	84.0	69.0	74.2	†	–	0.048	–	10	Str. .	2	Smoke,	–	–
23	68.0	77.0	68.0	71.0	–	–	–	–	5	Str. .	4	Str. .	10	Str. .
24	63.0	68.0	67.8	66.3	3 P. M.	–	–	–	10	Str. .	10	Str. .	10	Nim. .
25	68.9	79.1	70.5	72.8	5 A. M.‡	7 A. M.	0.904	–	10	Nim. .	7	Cum. .	1	Str.
26	64.2	77.3	63.8	68.4	–	–	–	–	–	Smoke,	–	Smoke,	–	Smoke,
27	56.9	81.0	67.0	68.3	–	–	–	–	5	Str. .	3	Str. .	5	Str. .
28	61.0	71.3	66.7	66.3	–	–	–	–	5	Str. .	8	Str. .	–	–
29	61.0	78.0	67.7	66.2	–	–	–	–	–	Smoke,	–	Smoke,	–	Smoke,
30	65.0	70.0	70.0	68.3	6 & 11 A. M.*	–	0.720	–	10	Nim. .	10	Str. .	–	Smoke,
31	68.2	82.8	75.2	75.4	§	–	0.033	–	10	Fog, .	3	Sm. & Cum. .	5	–
.	Mean, . . 73.97 Max., . . 94.5 Min., . . 61.0				Sum, . . . 3,284			–	Mean, ... 5.1					

* Thunder Showers. † Sprinkle. ‡ Shower. § Sprinkles in evening.

JULY, 1868.—CONTINUED.

WINDS.						BAROMETER.				FORCE OR PRESSURE OF VAPOR, IN INCHES.			RELATIVE HUMIDITY OR FRACTION OF SATURATION.			
7 A. M.		2 P. M.		9 P. M.		BAROMETER HEIGHT REDUCED TO FREEZING POINT.										
Direction.	Force.	Direction.	Force.	Direction.	Force.	7 A. M.	2 P. M.	9 P. M.	Mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Day of Month.
S. E.	1	S.W.	2	S.W.	1	29.939	29.910	29.917	29.922	.591	.690	.647	96	84	96	1
S. E.	1	S. E.	2	S. E.	3	29 936	29.928	29.852	29.906	.639	.904	.839	100	83	100	2
S. E.	1	S.	2	S. E.	2	29.871	29.800	29.855	29.842	.733	1.040	.758	100	78	90	3
S. E.	1	S.	1	S.W.	1	29.826	29.743	29.728	29.766	.733	.948	.973	95	90	98	4
S. E.	2	N.W.	3	N.	1	29.705	29.648	29.720	29.691	.908	.881	.847	99	58	92	5
N.	2	E.	2	S. E.	3	29.871	29.850	29.906	29.876	.511	.620	.470	66	67	88	6
S. E.	2	S.W.	3	S.W.	1	29.812	29.671	29.667	29.717	.504	.676	.678	95	87	100	7
S. W.	1	S.	2	E.	2	29.654	29.637	29.667	29.653	.709	.846	.768	100	84	100	8
N. E.	3	S. E.	2	S. E.	1	29.724	29.766	29.652	29.714	.700	.679	.645	99	90	94	9
N.W.	1	S.	2	S. E.	2	29.815	29.749	29.730	29.765	.563	.707	.763	94	66	94	10
–	–	W.	3	S.W.	1	29.764	29.676	29.675	29.705	.685	.735	.833	100	56	93	11
S. E.	1	N.W.	2	S. E.	1	29.704	29.646	29.686	29.679	.761	.832	.894	96	54	91	12
W.	1	N.W.	1	–	–	29.710	29.675	29.746	29.710	.854	.902	.819	95	58	98	13
S. E.	1	S.W	2	S. E.	2	29.772	29.706	29.695	29.724	.862	1.098	.914	93	75	95	14
S. E.	1	S.W.	2	W.	3	29.632	29.490	29.498	29.540	.851	1.154	.789	100	76	74	15
N.W.	3	E.	3	N.W.	2	29.514	29.590	29.649	29.584	.780	.778	.638	82	66	78	16
N.W.	3	N.W.	2	E.	1	29.757	29.694	29.703	29.718	.587	.673	.658	88	60	90	17
S. E.	1	E.	1	S. E.	3	29.717	29.634	29.660	29.670	.639	.599	.789	100	49	92	18
S. E.	1	–	–	W.	1	29.668	29.617	29.674	29.653	.731	951	.839	100	79	100	19
E.	1	N. E.	2	E.	1	29.757	29.797	29.834	29.796	.759	.740	.562	100	91	87	20
S. E.	1	S. E.	2	S. E.	2	29.808	29.726	29.667	29.734	.593	.726	.705	94	79	99	21
S. E.	1	S. E.	1	N.W.	1	29.599	29.505	29.559	29.554	.723	.802	.703	100	72	100	22
N.W.	3	S. E.	2	S. E.	3	29.663	29.638	29.653	29.651	.564	.660	.604	85	74	90	23
N.	2	N.	1	E.	1	29.646	29.600	29.571	29.608	.564	.652	.669	100	96	100	24
N.W.	1	S.	2	S.W.	1	29.481	29.477	29.564	29.507	.699	.817	.746	100	83	100	25
N.W.	1	N.W.	1	N.W.	1	29.710	29.745	29.760	29.738	.591	.516	.474	97	56	82	26
W.	1	S.W.	1	S. E.	1	29.831	29.768	29.775	29.791	.461	.455	.539	100	45	88	27
N.W.	1	S. E.	1	S. E.	1	29.885	29.755	29.765	29.802	.537	.672	.639	100	90	100	28
E.	1	S.W.	2	S. E.	3	29.822	29.786	29.816	29.808	.524	.722	.580	100	77	87	29
W.	1	S.	2	S.	1	29.802	29.771	29.775	29.783	.616	.746	.720	100	100	100	30
S. E.	1	S.	2	S. E.	3	29.741	29.629	29.558	29.643	.690	.925	.862	100	87	100	31

Per cent. of Time and Force: N. W. & W. 24; S. W. & S. 20; S. E. & E. 48; N. E. & N. 8.

Barometer: Mean, ... 29.718; Max., ... 29.939; Min., ... 29.481

Vapor: Mean, . . .722; Max., 1.154; Min., . . .455

Humidity: Mean, . . 87; Max., . . 100; Min., . . 45

AUGUST, 1868.

Day of Month.	Thermometer in the open air. 7 A. M.	2 P. M.	9 P. M.	Mean.	Rain and snow. Time of begin'g of rain or snow.	Time of ending of rain or snow.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Clouds. 7 A. M. Amount of cloudiness.	Kind of clouds.	2 P. M. Amount of cloudiness.	Kind of clouds.	9 P. M. Amount of cloudiness.	Kind of clouds.
1	72.0	81.9	72.7	75.5	6 P. M *	–	0.161	–	8	Str. .	9	Cu-str.	8	Str. .
2	72.0	84.2	74.0	76.7	–	–	–	–	3	Cir. .	3	Cum. .	5	Str. .
3	70.0	85.0	69.8	74.9	5 P. M.†	–	–	–	9	Str. .	2	Cum. .	10	Nim. .
4	68.3	68.2	68.0	71.5	–	2 P. M.	1.640	–	10	Nim. .	10	Nim. .	10	Str. .
5	65.7	73.3	69.8	69.6	Night.‡	–	0.726	–	10	Nim. .	10	Str. .	10	Str. .
6	62.7	73.2	65.0	67.0	–	–	–	–	8	Str. .	6	Str. .	9	Str. .
7	62.9	69.7	64.7	65.8	A. M.‡	–	–	–	7	Str. .	8	Cu. & Str.	10	Str. .
8	66.3	72.8	71.0	70.0	4 P. M.*	6 P. M.	1.028	–	10	Str. .	10	Str. .	10	–
9	71.0	79.4	67.7	72.7	6 P. M.†	–	0.432	–	10	Str. .	2	Cir. & Cum. .	10	Nim. .
10	62.7	74.0	65.0	67.2	–	–	–	–	–	–	2	Cum. .	8	Str. .
11	63.9	68.4	65.3	65.9	6 P. M.*	–	0.838	–	9	Str. .	10	Nim. .	8	Nim. .
12	61.2	72.0	57.0	63.4	‡	–	0.080	–	5	Str. .	8	Cu-str.	–	–
13	51.0	71.8	63.0	61.9	–	–	–	–	–	–	7	Str. .	1	Str. .
14	57.0	78.0	66.0	67.0	–	–	–	–	–	–	1	Cum. .	–	–
15	63.4	78.9	69.4	70.8	‡	–	0.110	–	3	Str. .	8	Str. .	9	Str. .
16	63.7	71.0	58.7	64.5	–	–	–	–	10	Nim. .	3	Cum. .	1	Str. .
17	51.8	69.8	62.5	61.4	–	–	–	–	2	Cir. .	1	Cum. .	–	–
18	61.0	73.1	68.5	67.5	–	–	–	–	7	Str. .	8	Str. .	10	Str. .
19	71.0	83.0	74.0	76.0	Night.‡	–	–	–	10	Str. .	6	Str. .	5	Str. .
20	71.7	74.0	69.8	71.8	*	–	0.453	–	10	Str. .	10	Nim. .	2	Str. .
21	67.0	78.8	68.9	71.6	–	–	–	–	5	Str. .	3	Str. & Cum. .	1	Str. .
22	62.0	77.9	63.8	67.9	–	–	–	–	2	Str. .	2	Cum. .	–	–
23	56.0	78.0	64.0	66.0	–	–	–	–	5	Fog, .	–	–	–	–
24	54.7	78.0	67.0	66.6	–	–	–	–	3	Cir. .	5	Str. .	7	Str. .
25	58.4	78.0	67.1	67.8	–	–	–	–	5	Fog, .	–	–	2	Str. .
26	65.0	81.5	69.8	72.1	–	–	–	–	5	Str. .	7	Str. .	2	Str. .
27	65.5	72.7	58.0	65.4	–	–	–	–	2	Str. .	5	Cu-str.	–	–
28	53.3	71.7	60.0	61.7	–	–	–	–	3	Str. .	–	–	–	–
29	62.0	78.6	70.0	70.2	–	–	–	–	4	Str. .	4	Cu-str.	1	Str. .
30	69.6	83.3	70.7	74.5	4 P. M.†	–	0.197	–	7	Str. .	8	Cu-str.	8	Str. .
31	62.6	79.8	71.0	71.1	–	–	–	–	3	Fog, .	3	Str. .	8	Str. .
	Mean, . . 68.97 Max., . . 85.0 Min., . . 51.0				Sums, . . . 5.665			–	Mean, ... 5.3					

* Shower. † Thunder Shower. ‡ Sprinkles.

AUGUST, 1868.—Continued.

Winds. 7 A. M. Direction.	Winds. 7 A. M. Force.	Winds. 2 P. M. Direction.	Winds. 2 P. M. Force.	Winds. 9 P. M. Direction.	Winds. 9 P. M. Force.	Barometer. Barometer height reduced to freezing point. 7 A. M.	2 P. M.	9 P. M.	Mean.	Force or Pressure of Vapor, In Inches. 7 A. M.	2 P. M.	9 P. M.	Relative Humidity or Fraction of Saturation. 7 A. M.	2 P. M.	9 P. M.	Day of Month.
S. E.	1	S.W.	3	S. E.	2	29.484	29.395	29.377	29.419	.785	.829.	782	100	77	99	1
S. E.	2	S.W.	2	S. E.	2	29.365	29.341	29.392	29.366	.780	.824	.825	100	73	100	2
S. E.	1	S.W.	2	N.W.	1	29.483	29.554	29.644	29.560	.728	.746	.720	100	64	100	3
N.W.	2	N.	2	S. E.	1	29.702	29.785	29.857	29.781	.691	.685	.673	100	100	100	4
N.W.	2	N. E.	1	N. E.	1	29.908	29.896	29.955	29.920	.622	.721	.636	100	88	89	5
N.W.	3	N. E.	3	N.W.	2	29.964	29.961	29.955	29.973	.552	.506	.529	98	63	86	6
N.W.	1	S. E.	1	E.	1	29.823	29.751	29.704	29.759	.564	.564	.593	100	70	99	7
S. E.	2	S.W.	2	S. E.	2	29.627	29.640	29.524	29.597	.639	.765	.746	100	98	100	8
S.	3	S.	4	E.	1	29.520	29.490	29.575	29.528	.754	.888	.667	100	74	100	9
N.W.	2	N.W.	2	S. E.	1	29.684	29.708	29.769	29.720	.566	.475	.546	100	58	92	10
S. E.	1	S.W.	3	-	-	29.765	29.717	29.622	29.701	.594	.641	.618	100	95	100	11
N.W.	2	N.	3	N.	1	29.590	29.617	29.734	29.647	.537	.429	.455	100	56	100	12
S. E.	1	N.W.	4	N.W.	1	29.826	29.741	29.760	29.776	.374	.400	.486	100	53	90	13
N.W.	1	S.W.	3	S. E.	1	29.802	29.764	29.772	29.779	.466	.489	.566	100	53	92	14
S. E.	2	S.W.	3	S.	3	29.772	29.687	29.654	29.704	.557	.614	.629	97	64	88	15
N.	1	N.	3	E.	1	29.661	29.703	29.814	29.726	.576	.466	.446	100	62	93	16
N.W.	1	S. E.	1	S. E.	2	29.951	29.940	29.966	29.955	.370	.476	.526	97	66	95	17
N.W.	1	S.W.	3	S.	3	29.996	29.961	29.928	29.962	.537	.629	.648	100	79	95	18
S.W.	3	S.W.	4	S.	1	29.812	29.709	29.725	29.749	.737	.859	.821	98	79	100	19
S.	3	S.	1	S. E.	1	29.679	29.635	29.659	29.658	.769	.839	.708	100	100	100	20
W.	2	N.W.	2	N. E.	1	29.765	29.764	29.829	29.716	.653	.609	.638	100	64	91	21
N.W.	2	N.	1	S. E.	1	29.896	29.839	29.859	29.865	.507	.512	.559	92	56	97	22
N.W.	1	N.W.	1	N.W.	1	29.849	29.765	29.735	29.783	.446	.567	.586	100	61	100	23
N.W.	1	E.	1	S. E.	1	29.755	29.715	29.731	29.734	.429	.600	.639	100	64	100	24
N.W.	1	S.	1	S. E.	1	29.802	29.765	29.806	29.758	.483	.632	.580	100	67	89	25
S. E.	2	S.W.	3	S. E.	1	29.833	29.795	29.800	29.809	.618	.829	.716	100	79	100	26
N. E.	3	E.	2	S. E.	1	29.914	29.975	30.037	29.975	.565	.605	.460	92	79	97	27
S.	1	S. E.	2	S. E.	2	30.080	29.994	29.970	30.015	.408	.503	.486	100	66	94	28
S. E.	2	S.W.	3	S. E.	3	29 830	29.732	29.693	29.752	.546	.742	.717	100	78	98	29
S. E.	2	S.W.	2	S. E.	1	29.686	29.618	29.735	29.680	.708	.854	.733	100	77	100	30
N.W.	2	S.W.	2	S. E.	3	29.823	29.762	29.723	29.769	.558	.682	.652	100	68	88	31

Winds	Barometer	Vapor	Humidity
Per cent. of Time and Force: N. W. & W. 23; S. W. & S. 34; S. E. & E. 32; N. E. & N. 11.	Mean, ... 29.748 Max., ... 30.080 Min., ... 29.341	Mean, . . .618 Max., . . .888 Min., . . .370	Mean, . . 89 Max., . . 100 Min., . . 53

SEPTEMBER, 1868.

Day of Month.	Thermometer in the open air. 7 A. M.	2 P. M.	9 P. M.	Mean.	Rain and snow. Time of begin'g of rain or snow.	Time of ending of rain or snow.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Clouds. 7 A. M. Amount of cloudiness.	Kind of clouds.	2 P. M. Amount of cloudiness.	Kind of clouds.	9 P. M. Amount of cloudiness.	Kind of clouds.
1	73.0	79.5	64.8	72.4	*	–	–	–	9	Str. .	5	Str. .	5	Str. .
2	58.5	72.8	61.8	64.4	–	–	–	–	7	Str. .	8	Cu-str.	8	Str. .
3	61.1	69.8	59.3	63.4	Night.	–	–	–	10	Str. .	7	Str. .	10	Str. .
4	56.2	61.8	61.7	59.9	–	Night.	3.459	–	10	Nim. .	10	Nim. .	10	Nim. .
5	61.8	73.6	60.0	65.1	–	–	–	–	9	Str. .	1	Str. .	–	–
6	53.7	71.0	64.7	63.1	–	–	–	–	2	Str. .	8	Cu-str.	9	Str. .
7	63.5	73.3	62.0	66.3	A. M.†	–	0.150	–	10	Str. .	7	Cu-str.	5	Str. .
8	54.0	70.0	59.8	61.3	–	–	–	–	–	–	–	–	–	–
9	58.5	65.3	65.0	62.9	Night.‡	–	–	–	9	Str. .	10	Str. .	10	Str. .
10	66.0	71.2	69.8	69.0	–	–	–	–	10	Nim. .	10	Str. .	10	Str. .
11	69.9	78.5	73.5	74.0	–	10 A. M.	1.308	–	10	Nim. .	8	Str. .	10	Str. .
12	71.8	76.5	69.5	72.6	Night.†	–	0.505	–	10	Str. .	10	Str. .	10	Nim. .
13	66.5	75.1	72.1	71.2	P. M.§	–	0.108	–	10	Str. .	9	Nim. .	9	Str. .
14	60.6	71.0	59.0	63.5	–	–	–	–	7	Str. .	7	Str. .	3	Str. .
15	51.0	69.1	56.8	59.0	–	–	–	–	–	–	–	–	9	Str. .
16	56.0	64.8	51.0	57.4	A. M.‡ Noon.†	–	0.147	–	10	Nim. .	8	Str. .	–	–
17	37.9	56.0	44.8	46.2	–	–	–	–	1	Str. .	3	Cu-str.	–	–
18	36.2	60.2	48.2	48.2	–	–	–	–	3	Fog, .	2	Cu-str.	–	–
19	38.0	63.5	53.0	51.5	–	–	–	–	1	Fog, .	3	Cir. .	1	Str. .
20	54.8	63.3	60.0	59.4	2 P. M.	Night.	0.278	–	9	Str. .	10	Str. .	10	Nim. .
21	47.2	56.8	46.0	50.0	–	–	–	–	–	–	–	–	–	–
22	37.0	59.7	53.7	66.8	Night.	–	–	–	1	Fog, .	7	Str. .	10	–
23	52.0	59.0	57.5	56.2	–	1 P. M.	0.331	–	10	Nim. .	10	Str. .	10	Str. .
24	49.7	54.0	46 0	49.9	5 P. M.	–	–	–	8	Str. .	9	Str. .	10	Nim. .
25	46.0	53.0	53.0	50.7	–	Night.	3.317	–	10	Nim. .	10	Str. .	10	Nim. .
26	56.0	61.1	52.0	56.4	Night.	–	–	–	8	Str. .	3	Str. .	6	Str. .
27	49.4	52.0	52.1	51.2	–	Night.	1.030	–	10	Nim. .	10	Nim. .	10	Nim. .
28	53.8	69.2	57.0	60.0	–	–	–	–	8	Str. .	3	Cu-str.	–	–
29	45.0	57.7	46.5	49.7	–	–	–	–	1	Str. .	3	Cu-str.	–	–
30	40.7	59.0	57.8	52.5	–	–	–	–	2	Cir. .	10	Str. .	7	Str. .
	Mean, . . 51.47 Max., . . 79.5 Min., . . 36 2				Sum, . .		10.633	–	Mean, ...					6.3

* A few drops. † Showers. ‡ Sprinkles. § Thunder shower.

SEPTEMBER, 1868.—Continued.

Winds 7 A. M. Direction.	Force.	2 P. M. Direction.	Force.	9 P. M. Direction.	Force.	Barometer Height Reduced to Freezing Point. 7 A. M.	2 P. M.	9 P. M.	Mean.	Force or Pressure of Vapor, in Inches. 7 A. M.	2 P. M.	9 P. M.	Relative Humidity or Fraction of Saturation. 7 A. M.	2 P. M.	9 P. M.	Day of Month.
S. E.	3	N.W.	4	N.W.	2	29.543	29.565	29.707	29.605	.812	.581	.493	100	60	83	1
N.W.	1	S.W.	2	S. E.	2	29.818	29.811	29.902	29.844	.483	.559	.537	100	72	100	2
S. E.	2	S. E.	3	S. E.	3	30.038	30.028	30.017	30.028	.500	.529	.426	93	75	85	3
N. E.	2	N.	2	N.	2	29.897	29.787	29.743	29.809	.449	.537	.543	100	100	100	4
N.W.	3	N.W.	4	N.W.	1	29.661	29.602	29.684	29.649	.543	.389	.434	100	48	86	5
N.W.	2	S.W	2	–	–	29.721	29.703	29.696	29.707	.394	.496	.464	97	65	77	6
W.	1	W.	3	N.W.	3	29.586	29.468	29.653	29.569	.576	.581	436	100	72	80	7
N.	1	N.	2	S.	2	29.817	29.771	29.772	29.787	.381	.367	.452	93	52	88	8
S. E.	2	S.	2	S. E.	1	29.718	29.618	29.674	29.670	.491	.583	.616	100	94	100	9
N.	1	S. E.	1	S. E.	1	29.705	29.700	29.730	29.712	.628	.764	.728	100	100	100	10
S. E.	2	S.	2	S. E.	1	29.778	29.803	29.837	29.806	.731	.877	.812	100	92	100	11
E.	1	E.	2	S. E.	1	29.861	29.808	29.802	29.824	.757	.819	.708	100	93	100	12
S. E.	1	N.W.	1	N.W.	2	29.717	29.647	29.744	29.703	.639	.853	.679	100	100	89	13
N.	3	N.	3	N.	1	29.878	29.909	29.951	29.913	.358	.526	.476	68	57	97	14
N.W.	1	E.	4	S. E.	3	30.014	29.937	29.910	29.954	.348	.411	.407	93	58	89	15
N.W.	1	W.	4	W.	2	29.694	29.585	29.722	29.667	.449	.464	.210	100	77	56	16
E.	1	W.	4	N. E.	1	29.900	29.858	29.965	29.908	.219	.204	.263	97	45	92	17
E.	1	N.W.	1	N.W.	1	30.112	30.090	30.119	30.109	.214	.267	.319	100	51	94	18
S. E.	1	S.W.	3	S. E.	2	30.235	30.136	30.093	30.155	.229	.327	.338	100	57	86	19
S.	3	S.W.	3	S.	2	29.941	29.721	29.628	29.863	.389	.456	.509	93	80	100	20
N.W.	4	N.W.	3	N.W.	1	29.757	29.771	29.817	29.782	.249	.217	.263	77	48	88	21
–	–	N.W.	1	S. E.	3	29.853	29.789	29.770	29.804	.221	.329	.332	100	66	83	22
S. E.	2	–	–	–	–	29.712	–	29.792	29.752	.383	–	.466	100	–	100	23
N.W.	3	N.W.	3	N. E.	2	29.982	29.982	29.916	29.960	.270	.217	.311	76	53	100	24
N. E.	2	N.W.	2	–	–	29.706	29.614	29.597	29.639	.311	.400	.403	100	100	100	25
N.W.	1	N.W.	2	N.W.	1	29.694	29.768	29.819	29.760	.421	.356	.358	94	67	93	26
N.	1	N.	1	N.	1	29.831	29.732	29.699	29.754	.349	.385	.385	100	100	100	27
S. E.	1	S. E.	2	N.W.	3	29.635	29.546	29.640	29.607	.411	.575	.329	100	81	72	28
S. E.	1	N.W.	6	N.W.	1	29.714	29.675	29.795	29.728	.300	.166	.215	100	36	69	29
N.W.	1	W.	3	S.W.	2	29.892	29.756	29.762	29.803	.255	.302	.396	100	61	84	30
Per cent. of Time and Force: N. W. & W. 44; S. W. & S. 13; S. E. & E. 30; N. E. & N. 13.						Mean, ... 29.792 Max., ... 30.235 Min., ... 29.468				Mean, . . .445 Max., . . .877 Min., . . .166			Mean, . . 86 Max., . . 100 Min., . . 36			

OCTOBER, 1868.

Day of Month.	Thermometer in the open air. 7 A. M.	2 P. M.	9 P. M.	Mean.	Rain and snow. Time of begin'g of rain or snow.	Time of ending of rain or snow.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Clouds. 7 A. M. Amount of cloudiness.	Kind of clouds.	2 P. M. Amount of cloudiness.	Kind of clouds.	9 P. M. Amount of cloudiness.	Kind of clouds.
1	48.5	51.5	47.3	49.1	*	–	–	–	9	Str. .	9	Str. .	10	Nim. .
2	46.0	55.5	49.0	50.2	Night.†	–	0.238	–	10	Str. .	9	Str. .	10	Nim. .
3	48.9	58.0	46.5	51.1	–	–	–	–	10	Nim. .	2	Str. .	–	–
4	36.0	58.6	48.0	47.5	–	–	–	–	2	Cir. .	2	Str. .	10	Str. .
5	44.0	61.7	53.5	53.1	–	–	–	–	10	Str. .	3	Cir. .	1	Str. .
6	51.9	64.0	48.0	54.6	–	–	–	–	–	Smoke,	2	Str. .	–	–
7	38.7	64.1	56.5	53.1	–	–	–	–	8	Fog, .	5	Str. .	10	Str. .
8	63.7	64.0	46.7	58.1	*	–	–	–	10	Nim. .	8	Str. .	9	Str. .
9	36.0	51.0	39.5	42.2	–	–	–	–	–	Str. .	–	–	–	–
10	32.9	55.0	46.0	44.6	–	–	–	–	7	Str. .	–	–	–	–
11	49.0	68.0	54.5	57.2	*	–	–	–	10	Str. .	–	–	–	–
12	47.7	59.8	48.0	57.8	–	–	–	–	3	Str. .	2	Cu-str.	–	–
13	35.0	57.3	48.0	46.8	Night.	–	–	–	–	–	7	Str. .	10	Str. .
14	44.4	49.0	47.8	47.1	–	–	–	–	10	Nim. .	10	Str. .	10	Str. .
15	47.0	54.9	52.3	51.4	–	6 A. M.	0.435	–	10	Nim. .	9	Str. .	9	Str. .
16	43.0	61.5	45.0	49.8	–	–	–	–	1	Str. .	–	–	–	–
17	38.0	40.5	30.3	36.3	6 A. M.	10 A. M.	0.235	1.0	10	Nim. .	2	Cu-str.	–	–
18	23.0	46.5	35.3	34.9	–	–	–	–	–	–	–	–	1	Str. .
19	40.8	47.9	47.0	45.2	1 P. M.	4 P. M.	–	–	7	Str. .	10	Nim. .	6	Str. .
20	37.8	52.0	37.5	42.4	–	–	–	–	2	Str. .	1	Cu-str.	–	–
21	39.2	43.0	42.0	41.4	11 A. M.	–	–	–	9	Str. .	10	Nim. .	10	Nim. .
22	34.2	39.7	36.0	36.7	–	Night.	0.285	–	10	Nim. .	10	Nim. .	10	Nim. .
23	33.0	37.2	35.0	35.1	–	–	–	–	2	Str. .	8	Str. .	–	–
24	19.2	42.0	32.3	31.2	–	–	–	–	1	Str. .	–	–	–	–
25	27.0	48.5	45.4	40.3	Night.†	–	0.103	–	3	Str. .	3	Str. .	10	Nim. .
26	46.0	54.6	43.0	47.7	–	–	–	–	9	Nim. .	8	Str. .	3	Str. .
27	29.5	50.8	50.0	43.4	Night.*	–	0.075	–	1	Fog, .	9	Str. .	10	Str. .
28	55.0	56.0	42.0	51.0	–	–	–	–	9	Nim. .	7	Str. .	3	Str.
29	32.3	40.2	29.0	33.8	–	–	–	–	–	Str. .	1	Str. .	–	–
30	21.5	43.0	31.7	32.1	–	–	–	–	–	–	–	–	–	–
31	27.5	52.8	54.8	45.0	–	–	–	–	7	Str. .	8	Str. .	10	Str. .
	Mean, . . 45.30 Max., . . 68.0 Min., . . 19.2				Sums, . . . 1.371			1.0	Mean, ... 4.9					

* Sprinkles. † Rain.

OCTOBER, 1868.—Continued.

Winds. 7 A. M. Direction.	Force.	2 P. M. Direction.	Force.	9 P. M. Direction.	Force.	Barometer. Barometer height reduced to freezing point. 7 A. M.	2 P. M.	9 P. M.	Mean.	Force or Pressure of Vapor, in Inches. 7 A. M.	2 P. M.	9 P. M.	Relative Humidity or Fraction of Saturation. 7 A. M.	2 P. M.	9 P. M.	Day of Month.
N.W.	2	S. E.	2	S. E.	1	29.983	30.034	30.069	30.029	.242	.265	.303	72	71	94	1
N.W.	1	S.W.	1	S.	1	30.066	29.988	29.982	30.012	.262	.314	.340	84	77	99	2
N.	1	N.	3	N.W.	1	29.899	29.878	29.957	29.911	.339	.303	.262	100	63	84	3
N.W.	1	S.W.	2	S. E.	2	30.032	29.914	29.853	29.933	.212	.309	.477	100	64	100	4
E.	1	S. E.	2	E.	1	29.655	29.416	29.358	29.476	.289	.417	.576	100	77	100	5
N.W.	2	N.W.	4	E.	1	29.504	29.660	29.835	29.666	.310	.299	.294	81	52	90	6
N.W.	2	S. E.	3	S. E.	3	29.938	29.806	29.751	29.832	.231	.436	.420	100	74	94	7
S. E.	4	W.	3	N.W.	4	29 570	29.524	29.755	29.616	.590	.403	.210	100	67	68	8
N.W.	1	N.W.	2	N.W.	1	29.973	29.972	30.010	29.985	.180	.164	.195	85	45	82	9
W.	1	N.W.	2	N.W.	1	29.993	29.880	29.871	29.915	.184	.358	.267	100	84	88	10
S. E.	1	S.W.	3	N.	1	29.762	29.620	29.681	29.688	.349	.475	.418	100	69	100	11
S.W.	2	N.W.	6	S. E.	2	29.738	29.736	29.882	29.785	.293	.216	.217	89	43	66	12
E.	1	S.W.	3	S. E.	1	29 952	29.882	29.916	29.917	.203	.291	.263	100	62	79	13
N.E.	1	E.	1	-	-	29.972	29.937	29.916	29 942	.289	.323	.327	100	94	100	14
N.W.	2	N.W.	2	N.W.	2	29.874	29.765	29.699	29.779	.323	.386	.388	100	90	100	15
N.W.	1	W.	2	N.W.	1	29.639	29.584	29.631	29.618	.278	.297	.285	100	55	96	16
N.W.	3	N.W.	5	N.W.	3	29.631	29.848	30.075	29.851	.229	.162	.114	100	63	69	17
S. E.	1	S.W.	4	S. E.	1	30.160	30.044	30.012	30.072	.123	.163	.162	100	52	80	18
S. E.	2	S.W.	2	W.	3	29.868	29.689	29.726	29.761	.199	.327	.249	78	100	77	19
N.W.	1	N.W.	2	N.W.	1	29.840	29.830	29.930	29.867	.218	.201	.206	98	52	95	20
N.W.	1	N.W.	1	N.	1	29.927	29.876	29.780	29.861	.216	.271	.266	91	98	100	21
N.W.	1	N.	2	N.	1	29.696	29.775	29.780	29.750	.196	.230	.212	100	95	100	22
N.	2	N.	3	N.	1	30.023	30.124	30.198	30.115	.178	.136	.166	94	60	82	23
N.	1	S.W.	2	E.	1	30.127	30.093	30.051	30.120	.101	.187	.176	100	69	97	24
W.	1	S.W.	2	S.	1	29.980	29.826	29.783	29.830	.145	.258	.288	100	78	94	25
W.	1	N.W.	3	N.W.	1	29.726	29.778	29.947	29.817	.311	.308	.227	100	74	83	26
N.W.	1	S.W.	3	S.	2	30.035	29.930	29.830	29.932	.153	.286	.331	100	78	93	27
S.	2	W.	4	N.W.	4	29.585	29.578	29.767	29.643	.433	.288	.184	100	64	70	28
N W.	3	N.W.	4	N.W.	1	30.025	30.050	30.168	30.081	.125	.118	.135	69	48	88	29
N.W.	1	N E.	1	E.	1	30.320	30.319	30.363	30.334	.113	.103	.133	100	37	76	30
E.	1	S.	4	S.	4	30.321	30.084	29.878	30.094	.147	.292	.380	100	73	89	31
Per cent. of Time and Force: N. W. & W. 52; S. W. & S. 20; S. E. & E. 19; N. E. & N. 9.						Mean, . . .			29.876	Mean, . . .265			Mean, . . 84			
						Max., . . .			30.363	Max , . . .590			Max., . . 100			
						Min., . . .			29.358	Min., . . .101			Min., . . 37			

NOVEMBER, 1868.

Day of Month.	Thermometer in the open air. 7 A. M.	2 P. M.	9 P. M.	Mean.	Rain and Snow. Time of begin'g of rain or snow.	Time of ending of rain or snow.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Clouds. 7 A. M. Amount of cloudiness.	Kind of clouds.	2 P. M. Amount of cloudiness.	Kind of clouds.	9 P. M. Amount of cloudiness.	Kind of clouds.
1	58.0	52.8	41.2	50.7	Night.	–	–	–	10	Nim. .	10	Nim. .	10	Nim. .
2	34.0	35.8	33.7	34.5	–	–	–	–	10	Nim. .	10	Nim. .	10	Nim. .
3	31.3	39.0	31.3	33 9	–	8 A. M.	2.534	1.0	10	Nim.	7	Str. .	1	Str. .
4	26 0	50.0	39.9	38.6	–	–	–	–	–	Str. .	–	–	1	Str. .
5	36.0	40.2	42.3	39.5	9 A. M.	2 P. M.	0.150	–	10	Str. .	10	Nim. .	2	Str. .
6	39.9	43.0	33.0	38.6	–	–	–	–	3	Str. .	4	Str. .	–	–
7	30.0	41.8	31.8	34.5	–	–	–	–	–	–	2	Cir. .	5	Str. .
8	32.8	35.3	37.0	35.0	11 A. M.	–	–	–	10	Str. .	10	Nim. .	10	Nim. .
9	38.4	53.0	50.5	47.3	–	–	–	–	10	Fog, .	9	Str. .	10	Str. .
10	43.2	41.3	37.5	40.7	–	–	–	–	10	Str. .	10	Nim. .	10	Nim. .
11	39.0	42.2	34.8	38.7	–	Noon.	0.687	–	10	Nim. .	9	Str. .	–	–
12	30.8	38.2	30.0	33.0	–	–	–	–	1	Str. .	4	Cu-str.	–	–
13	28.0	46.0	34.0	36.0	–	–	–	–	3	Str. .	2	Cir. .	–	–
14	30.3	51.0	32.5	38.0	–	–	–	–	–	Str. .	5	Str. .	–	–
15	27.8	39.3	34.0	33.7	–	–	–	–	9	Str. .	1	Str. .	10	Str. .
16	25.5	37.5	28.8	30.6	–	–	–	–	2	Str. .	–	–	–	–
17	24.7	35.3	33.0	30.7	Night.	–	–	–	8	Str. .	10	Str. .	10	Str. .
18	34.0	35.5	34.5	34.7	–	Noon.	0.700	0.5	10	Nim. .	10	Nim. .	10	Str. .
19	34.3	42.5	30.5	35.8	–	–	–	–	9	Str. .	3	Cu-str.	–	–
20	23.8	38.0	33.0	31.6	–	–	–	–	1	Str. .	9	Str. .	3	Str. .
21	33.0	36.5	34.0	34.5	–	–	–	–	10	Str. .	9	Str. .	10	Str. .
22	34.4	37.0	34.8	35.4	–	–	–	–	10	Str. .	9	Str. .	8	Str. .
23	27.2	38.3	29.9	31.8	–	–	–	–	–	–	–	–	–	–
24	29.8	45.2	36.7	37.2	–	–	–	–	2	Str. .	2	Cum. .	3	Str. .
25	26.2	43.0	37.0	35.4	Night.	–	–	–	4	Str. .	5	Cir. .	10	Str. .
26	42.0	44.4	42.5	43.0	–	6 P. M.	0.700	–	10	Str. .	10	Nim. .	5	Str. .
27	33.3	39.1	31.8	34.7	–	–	–	–	2	Str. .	1	Cu-str.	4	Str. .
28	27.3	41.8	36.7	35.3	*	–	–	–	7	Str. .	2	Str. .	10	Nim. .
29	31.7	43.0	36.7	37.1	–	–	–	–	10	Fog, .	5	Str. .	9	Str. .
30	34.5	36.8	30.3	33.9	10 A. M.	Night.	0.025	–	9	Str. .	10	Nim. .	10	Str. .
	Mean, . . 36.48 Max., . . 58.0 Min., . . 23.8				Sums, . . .		4.796	1.5	Mean, ... 5.7					

* Film of snow.

NOVEMBER, 1868.—CONTINUED.

WINDS. 7 A. M. Direction.	Force.	2 P. M. Direction.	Force.	9 P. M. Direction.	Force.	BAROMETER HEIGHT REDUCED TO FREEZING POINT. 7 A. M.	2 P. M.	9 P. M.	Mean.	FORCE OR PRESSURE OF VAPOR, IN INCHES. 7 A. M.	2 P. M.	9 P. M.	RELATIVE HUMIDITY OR FRACTION OF SATURATION. 7 A. M.	2 P. M.	9 P. M.	Day of Month.
S. E.	6	–	–	N.	2	29.465	29.345	29.425	29.412	.480	.395	.258	100	100	100	1
N.	4	N.	4	N.W.	1	29.559	29.597	29.674	29.610	.196	.194	.186	100	92	96	2
N.W.	2	N.W.	2	N.W.	1	29.653	29.619	29.639	29.637	.175	.175	.174	100	73	100	3
N.W.	1	S.W.	2	N.W.	1	29.764	29.633	29.638	29.678	.141	.234	.226	100	65	91	4
N.E.	2	W.	1	N.W.	3	29.516	29.434	29.549	29.500	.212	.250	.218	100	100	81	5
N.W.	4	N.W.	5	N.W.	4	29.738	29.838	29.972	29.849	.187	.182	.150	77	66	80	6
N.W.	1	N. E.	2	N.W.	2	30.115	30.138	30.210	30.154	.139	.143	.147	83	55	84	7
N.W.	1	N.W.	1	S.	1	30.190	29.952	29.901	30.014	.163	.206	.221	87	100	100	8
N.W.	1	E.	1	N.W.	1	29.741	29.685	29.715	29.714	.234	.403	.361	100	100	100	9
E.	3	N. E.	3	N. E.	2	29.894	29.885	29.883	29.887	.268	.249	.214	96	96	95	10
N. E.	3	N.W.	3	W.	1	29.631	29.528	29.682	29.614	.236	.224	.155	100	83	76	11
W.	1	N.W.	4	N.W.	1	29.861	29.936	30.102	29.966	.139	.114	.126	81	52	76	12
S. E.	2	S. E.	2	E.	1	30.139	29.993	30.002	30.011	.152	.181	.178	100	59	92	13
S. E.	1	S.W.	2	E.	1	30.000	29.938	29.973	29.970	.164	.120	.162	97	28	89	14
N. E.	1	W.	1	N.W.	1	30.069	30.033	30.067	30.056	.149	.184	.160	100	77	81	15
N.W.	3	N.W.	2	N.W.	2	30.151	30.102	30.135	30.129	.132	.128	.109	96	58	70	16
E.	1	W.	1	E.	3	30.109	29.998	29.952	30.020	.126	.162	.188	96	80	100	17
N. E.	4	N. E.	2	N.W.	3	29.633	29.515	29.533	29.560	.196	.207	.200	100	100	100	18
N.W.	1	N.W.	2	N.W.	1	29.589	29.546	29.589	29.575	.196	.193	.170	100	71	100	19
S. E.	1	S.W.	1	S. E.	2	29.588	29.534	29.506	29.543	.125	.186	.159	100	83	85	20
N.	3	N.	3	N.	3	29.439	29.388	29.430	29.419	.163	.146	.188	86	69	71	21
N.	4	N.	4	N.	4	29.454	29.514	29.616	29.528	.147	.155	.150	74	70	75	22
N.W.	1	N.W.	3	S. E.	1	29.730	29.757	29.779	29.755	.147	.149	.153	100	65	94	23
S. E.	1	N.W.	3	N.	2	29.725	29.676	29.833	29.745	.160	.178	.165	100	60	78	24
S. E.	2	S. E.	3	S. E.	2	29.902	29.870	29.792	29.855	.137	.121	.181	100	64	83	25
S.	3	N.	3	N.W.	5	29.521	29.084	29.314	29.306	.267	.289	.215	100	100	79	26
N.W.	5	N.W.	4	S. E.	1	29.640	29.731	29.885	29.752	.150	.134	.157	80	57	92	27
S. E.	1	S.W.	3	S.W.	1	29.747	29.581	29.473	29.600	.142	.183	.189	96	70	88	28
E.	1	N.W.	3	N.W.	4	29.322	29.260	29.266	29.283	.176	.184	.161	100	66	74	29
S.W.	1	S.W.	1	N.	3	29.118	29.092	29.213	29.141	.161	.216	.157	81	100	94	30

Per cent. of Time and Force: N. W. & W. 45; S. W. & S. 8; S. E. & E. 19; N. E. & N. 28.

Barometer: Mean, ... 29.699; Max, ... 30.212; Min., ... 29.084

Vapor: Mean, . . .176; Max, . . .480; Min., . . .114

Relative humidity: Mean, . . 95; Max., . . 100; Min., . . 28

DECEMBER, 1868.

Day of Month.	Thermometer in the open air. 7 A. M.	2 P. M.	9 P. M.	Mean.	Rain and snow. Time of begin'g of rain or snow.	Time of ending of rain or snow.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Clouds. 7 A. M. Amount of cloudiness.	Kind of clouds.	2 P. M. Amount of cloudiness.	Kind of clouds.	9 P. M. Amount of cloudiness.	Kind of clouds.
1	22.0	25.0	20.8	22.6	Night.*	–	–	–	10	Nim.	9	Str.	3	Str.
2	23.3	28.3	22.8	23.3	–	–	–	–	10	Str.	2	Str.	–	–
3	16.1	32.5	26.0	24.5	–	–	–	–	–	–	4	Str.	–	–
4	17.8	32.5	23.0	24.4	Night.	–	–	–	1	Str.	10	Str.	8	Str.
5	26.0	28.8	27.0	27.3	–	Night.	0.490	7.0	10	Nim.	10	Nim.	10	Nim.
6	25.0	33.0	27.2	28.4	–	–	–	–	7	Str.	–	Str.	10	Str.
7	25.7	32.6	42.7	33.7	Noon.	Night.	0.495	3.0	10	Str.	10	Nim.	10	–
8	36.4	35.3	30.0	33.9	Night.†	–	–	–	7	Str.	7	Str.	10	Nim.
9	20.6	26.1	18.8	21.6	†	–	–	–	8	Str.	9	Nim.	–	–
10	12.5	21.0	13.9	15.8	–	–	–	–	2	Str.	1	Str.	5	Str.
11	1.5	22.5	19.8	14.6	–	–	–	–	1	Str.	6	Str.	10	Str.
12	19.3	24.3	24.8	22.8	–	–	–	–	9	Str.	2	Str.	–	–
13	19.5	29.7	18.3	22.5	–	–	–	–	2	Str.	3	Str.	–	–
14	18.0	25.9	22.3	22.1	*	–	–	–	9	Str.	10	Str.	7	Str.
15	16.0	28.1	13.4	19.2	–	–	–	–	1	Str.	–	Str.	–	–
16	8.0	22.7	23.8	18.2	–	–	–	–	3	Str.	9	Str.	10	Str.
17	25.3	37.0	38.7	33.7	–	–	–	–	10	Str.	2	Str.	5	Str.
18	38.0	29.5	18.5	28.7	–	–	–	–	8	Str.	1	Str.	–	–
19	8.5	19.0	9.5	12.3	–	–	–	–	–	–	–	–	–	–
20	16.0	20.5	34.0	23.5	9 A. M.	Night.	0.257	0.5	10	Str.	10	Nim.	10	Nim.
21	33.8	40.0	36.0	36.6	–	–	–	–	10	Fog,	8	Str.	8	–
22	30.0	34.5	29.8	31.4	–	–	–	–	5	Str.	4	Cu-str.	6	Str.
23	26.8	26.0	17.0	23.3	5 A. M.	11 A. M.	0.092	1.5	10	Nim.	5	Str.	–	–
24	3.0	17.2	4.2	8.1	–	–	–	–	–	Str.	–	–	–	–
25	-4.0	20.4	17.0	11.1	–	–	–	–	1	Str.	4	Str.	7	Str.
26	17.7	21.0	6.5	15.1	–	–	–	–	4	Str.	–	–	–	–
27	-5.0	14.0	18.0	9.0	1 P. M.	Night.	0.097	1.0	1	Str.	10	Nim.	10	Nim.
28	21.0	31.8	19.7	24.2	–	–	–	–	6	Str.	5	Str.	–	–
29	16.3	32.0	36.5	28.3	‡	–	0.020	–	8	Str.	10	Nim.	5	–
30	21.7	–	–	–	–	–	–	–	3	Str.	–	–	–	–
31	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Mean,			.00	Sums,		00	00	Mean,					.00
	Max.,			.00										
	Min.,			.00										

* Film of snow. † Squalls. ‡ A little snow and rain.

DECEMBER, 1868.—CONTINUED.

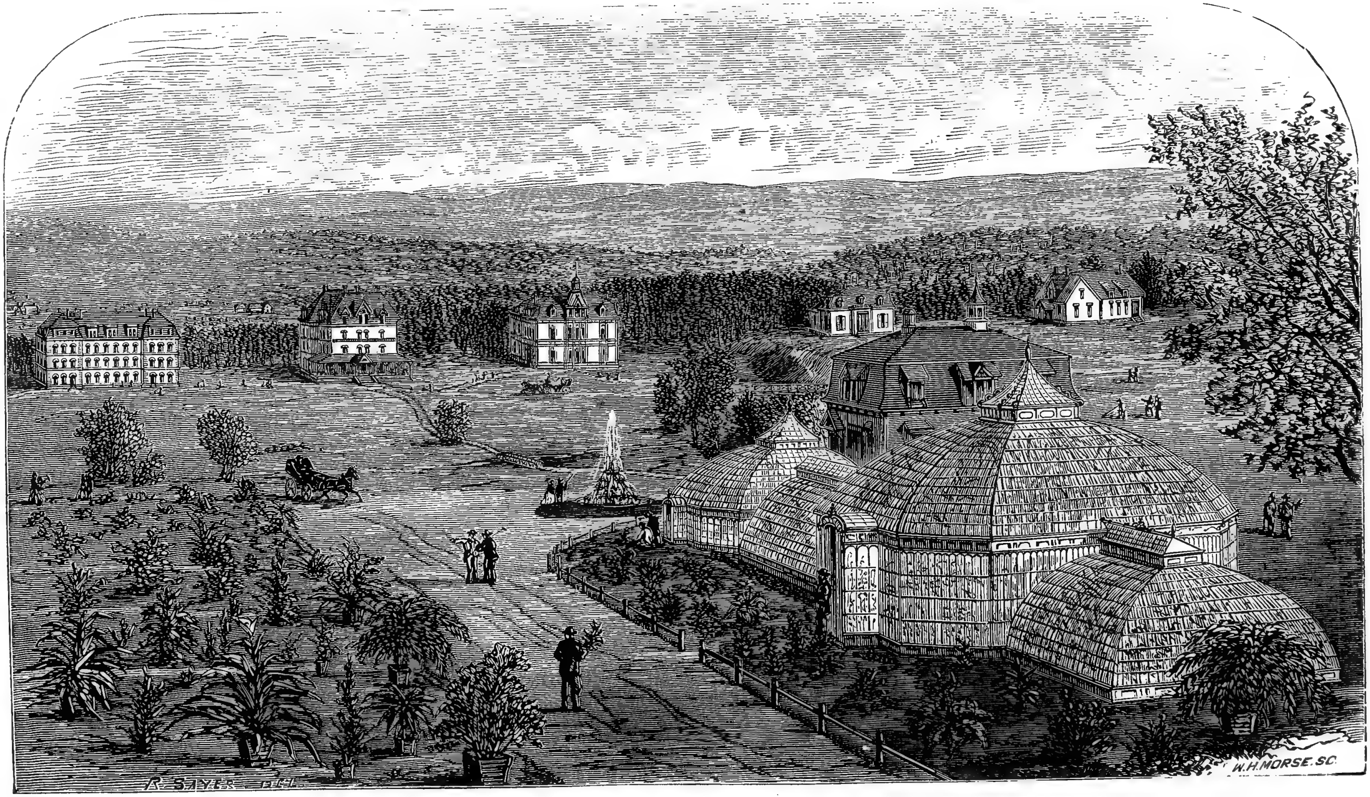
WINDS.						BAROMETER.				FORCE OR PRESSURE OF VAPOR, IN INCHES.			RELATIVE HUMIDITY OR FRACTION OF SATURATION.			
7 A. M.		2 P. M.		9 P. M.		BAROMETER HEIGHT REDUCED TO FREEZING POINT.										
Direction.	Force.	Direction.	Force.	Direction.	Force.	7 A. M.	2 P. M.	9 P. M.	Mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Day of Month.
N.	3	N.W.	4	N.W.	4	29.279	29.267	29.427	29.324	.101	.096	.091	86	71	85	1
S.W.	4	N.W.	4	N.W.	3	29.577	29.615	29.759	29.650	.103	.105	.107	83	69	93	2
N.W.	1	N.W.	4	N.W.	1	29.922	29.902	29.992	29.938	.087	.119	.129	100	64	91	3
S. E.	1	E.	1	S.W.	2	29.975	29.921	29.865	29.920	.095	.176	.123	100	100	100	4
E.	2	N.	2	N.	2	29.755	29.635	29.699	29.696	.140	.157	.147	100	100	100	5
N.	1	N.W.	1	N. E.	1	29.826	29.855	29.947	29.876	.133	.163	.141	100	86	94	6
S. E.	2	N.E.	5	S. E.	6	29.819	29.331	28.681	29.277	.137	.185	.257	100	100	94	7
W.	4	N.W.	5	N.W.	4	29.879	29.979	29.056	28.971	.211	144	.164	98	61	100	8
N.W.	5	N.W.	3	S.W.	3	29.314	29.468	29.616	29.466	.098	.114	.093	88	81	96	9
N.E.	1	S.W.	2	S.W.	2	29.653	29.643	29.701	29.666	.076	.096	.078	100	88	100	10
E.	1	N.W.	1	N.W.	3	29.687	29.550	29.436	29.558	.047	.097	.097	100	83	96	11
N.W.	3	N.W.	4	N.W.	4	29.527	29.679	29.482	29.683	.098	.102	.105	94	79	80	12
S. E.	2	W.	3	W.	1	29.952	29.955	29.980	29.962	.103	.118	.098	100	75	100	13
E.	1	S. E.	2	E.	1	29.900	29.745	29.655	29.767	.095	.115	.110	96	85	94	14
S. E.	1	N.W.	1	W.	1	29.744	29.853	29.943	29.847	.086	.125	.090	100	82	100	15
S. E.	1	S. E.	2	N. E.	1	29.804	29.624	29.420	29.616	.062	.115	.126	100	100	100	16
N.W.	1	S.W.	2	N.W.	4	29.192	28.976	28.991	29.053	.135	.176	.155	100	81	66	17
N.W.	4	N.W.	5	N.W.	4	29.112	29.341	29.619	29.357	.168	.118	.090	74	75	92	18
N.W.	3	N.W.	2	N.W.	1	29.952	30.118	30.191	30.087	.055	.061	.066	88	60	100	19
S.	1	S.W.	1	S W.	1	30.058	29.776	29.588	29.807	.086	.108	.196	100	100	100	20
N.W.	1	W.	1	W.	2	29.477	29.460	29.577	29.505	.192	.193	.149	100	80	71	21
N.W.	1	N.W.	4	N.W.	3	29.708	29.758	29.826	29.764	.146	.125	.131	89	63	91	22
S. E.	2	N.W.	3	N.W.	2	29.714	29.662	29.700	29.692	.144	.108	.087	100	80	95	23
S. E.	1	N.W.	3	N.W.	3	29.616	29.517	29.589	29.574	.049	.066	.052	100	71	100	24
S. E.	1	W.	3	S.W.	1	29.624	29.535	29.604	29.588	.036	.091	.083	100	85	89	25
W.	4	N.W.	2	N.W.	2	29.832	29.989	30.149	29.990	.078	.085	.058	83	78	100	26
S. E.	1	S.W.	1	S. E.	1	30.239	30.185	30.077	30.167	.035	.078	.095	100	100	100	27
N.W.	1	N.W.	2	S. E.	1	29.934	29.961	30.071	29.989	.112	.155	.100	100	87	100	28
E.	2	S.	3	W.	2	29.985	29.704	29.698	29.769	.088	.181	.168	100	100	78	29
W.	1	–	–	–	–	30.000	–	–	–	.103	–	–	94	–	–	30
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	31

Per cent. of Time and Force:	Barometer	Vapor	Humidity
N. W. & W. 00; S. W. & S. 00; S. E. & E. 00; N. E. & N. 0.	Mean, ... 00 Max., ... 00 Min., ... 00	Mean, . 00 Max., . 00 Min., . . 00	Mean, . . 00 Max., . . 00 Min., . . 00

SUMMARY, 1868.

MONTHS.	THERMOMETER IN THE OPEN AIR.			RAIN AND SNOW.		CLOUDS.	WINDS. Per Cent. of Direction.				BAROMETER. Barometer height reduced to freezing point.			FORCE OR PRESSURE OF VAPOR, IN INCHES.			RELATIVE HUMIDITY OR FRACTION OF SATURATION.		
	Maximum.	Minimum.	Mean.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Mean amount of cloudiness.	N.W. & W.	S W. & S.	S. E. & E.	N. E. & N.	Maximum.	Minimum.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
January, . .	39.5	0.0	20.21	3.517	26.0	5.1	61	7	11	21	30.219	29.009	29.686	.212	.041	.106	100	47	91
February, .	45.0	−18.3	18.21	1.030	9.0	4.1	57	17	19	7	30.526	29.132	29.852	.225	.015	.099	100	26	90
March, . .	59.8	−7.3	33.80	3.249	10.0	4.8	34	15	34	19	30.360	28.953	29.758	.361	.031	.162	100	23	82
April, . .	67.5	23.0	41.96	4.270	16.0	5.2	48	27	14	11	30.193	28.755	29.721	.499	.088	.211	100	25	77
May, . . .	75.0	36.0	55.13	7.863	–	7.1	24	14	28	34	29.997	29.209	29.624	.696	.139	.365	100	28	83
June, . .	88.7	51.8	66.17	2.441	–	5.1	27	18	41	14	30.142	29.333	29.753	.904	.262	.535	100	40	84
July, . . .	94.5	61.0	73.97	3.284	–	5.1	24	20	48	8	29.939	29.481	29.718	1.154	.455	.722	100	45	87
August, . .	85.0	51.0	68.97	5.665	–	5.3	23	34	32	11	30.080	29.341	29.748	.888	.370	.618	100	53	89
September, .	79.5	36.2	59.47	10.633	–	6.3	44	13	30	13	30.235	29.468	29.792	.877	.166	.445	100	36	86
October, . .	68.0	19.2	45.30	1.371	–	4.9	52	20	19	9	30.363	29.358	29.876	.590	.101	.265	100	37	84
November, .	58.0	23.8	36.48	4.796	1.5	5.7	45	8	19	28	30.212	29.094	29.699	.480	.114	.176	100	28	95
December, .	42.7	−9.0	22.82	1.471	13.0	5.1	63	12	16	9	30.239	28.681	29.697	.257	.035	.114	100	60	95
YEAR, . .	94.5	−18.3	45.21	48.590	75.5*	5.3	42	17	26	15	30.526	28.681	29.744	1.154	.015	.318	100	23	87

* Winter of 1867–8, 69.5.



DURFEE PLANT HOUSE.

SENATE...... ......No. 6.

SEVENTH ANNUAL REPORT

OF THE

TRUSTEES

OF THE

Massachusetts Agricultural College.

JANUARY, 1870.

BOSTON:
WRIGHT & POTTER, STATE PRINTERS,
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1870.

Commonwealth of Massachusetts.

AMHERST, January 14th, 1870.

HON. H. H. COOLIDGE, *President of Massachusetts Senate.*

SIR :—I have the honor herewith to transmit to the legislature, in accordance with the requirements of law, the Seventh Annual Report of the Trustees of the Massachusetts Agricultural College.

Very respectfully,
Your obedient servant,

W. S. CLARK,
President.

ANNUAL REPORT.

To the Honorable Senate and House of Representatives:

The Trustees of the Massachusetts Agricultural College respectfully submit the following Report concerning the progress and condition of the institution under their charge.

Thanks to a kind Providence, the record of the year 1869 is one of continued and growing prosperity. The estate has been much improved and supplied with necessary buildings and live stock; the means of scientific illustration and conveniences for instruction have been largely increased; and the number of friends, teachers and students multiplied. The liberal aid uniformly granted by past legislatures for the development of the College has inspired the people of the Commonwealth with confidence in its permanence, its utility, and its final success.

Agricultural Department.

During the past year special effort has been made to promote the interest and elevate the character of this most important department.

A commodious dwelling for the farm superintendent has been erected, at a cost of $4,000, near the south line of the College property on the central ridge, by Mr. L. N. Granger, of Hadley.

The new barn is located a few rods north-west of this house, and was built by Mr. C. W. Lessey, of Amherst. It is a substantial but plain structure of wood, upon a granite foundation. The cellar for manure extends under the entire main building, and is one hundred feet in length, fifty feet wide, and ten feet deep. It is accessible with teams at the west end by two nearly level drive-ways twelve feet in width, and is well lighted and ventilated by windows on the north and south sides.

The lower story, immediately over the cellar, is eight feet high in the clear, and well lighted by windows on the north, west and south. Ventilation is secured by flues in each corner, which extend to the roof, and by the upper sashes of the windows, which are hung with weights. On the east end of this floor is a room for roots, which are dumped from the drive-way in the story above on to a screen in the form of an A, which breaks their fall and throws them each way toward the ends of the room, at the same time separating from them any loose earth brought from the field. The stone wall at the east end of the cellar is carried up eighteen feet to support the embankment made for the drive-way into the upper story, and thus secures the roots from frost. The remainder of the lower story is occupied by stalls for cattle. The bulls are kept in box-stalls which are twelve by ten feet; the cows are secured by stanchions upon platforms four and one-half feet wide; and the rest of the stock are fastened with chains. There are four tiers of stalls running across the barn and surrounded on all sides by passage-ways of convenient width. The three outside doors of this floor open on the south side of the barn into a yard one hundred by seventy-five feet. This is sheltered on the west by an ell containing a sheep-pen and cattle-shed, which is seventy-five feet long by twenty-six feet wide. The whole establishment will accommodate, in an excellent manner, fifty neat cattle and fifty sheep, while the cellar, being light and sufficiently ventilated, is well adapted for swine.

Soft, running water is supplied in abundance both to the yard and sheep-pen. The barn stands upon the western slope of the ridge, with the main entrance at the east end. The upper floor is reached by a road rising from the summit of the ridge to the barn, about six feet in one hundred. The drive-way through the upper floor is fifteen feet wide, and the exit is at the west end, over a platform of timber which has an inclination considerably greater than that at the entrance. In the drive-way is a Fairbanks hay-scale of the best quality, capable of weighing four tons. Near the centre of the barn, on each side of the threshing-floor, is a compartment seventeen feet long and fourteen feet wide, with a double window. In the north one are the stairs leading to the story below and bins for grain. That on the south side is designed for a horse power for threshing

and cutting fodder. The main floor of the barn is thus divided into four bays, each forty-three feet long, seventeen feet wide, and sixteen feet to the plates, affording room for one hundred tons of hay, and by using the space under the roof and a scaffold over the threshing floor, the capacity may be very largely increased. This story is well ventilated through the cupola and by the windows, which are six in number, besides those over the doors. The entire cost of the barn was about $10,000.

Horse and ox-teams, wagons, carts, and agricultural implements are provided for in the barns on the north side of the estate.

Substantial, board fences have been built at a suitable distance from the north and south boundaries of the farm to form convenient roadways, through which teams may pass or cattle be driven from the barns either to the county road or to the pastures on the river.

A large amount of work has been done in under-draining; grading on the farm, along the highway, and about the new buildings; and in repairing and constructing roads and bridges.

Among the results of ordinary farm operations may be mentioned the laying down to grass of about fifteen acres, the hay crop of one hundred and fifty tons, seven hundred bushels of corn, six hundred of oats, and six hundred of potatoes.

The College now owns good specimens of the four principal breeds of cattle.

The Shorthorns are represented by a bull, Mountain Lad, bred by Augustus Whitman, of Fitchburg; a cow, Young Acacia, bred by G. Munson, of Huntington; a heifer, Yarico 57th, from the herd of Paoli Lathrop, of South Hadley; and another, Autumn Rose, from that of Phineas Stedman, of Chicopee.

The Devons are from the stock of E. H. Hyde, of Stafford, Conn., and consist of a bull, General Lyon; and two cows, Gem 3d and Winona 2d.

The Ayrshires are a bull, Colfax, bred by H. S. Collins, of Collinsville, Conn.; and a heifer, Lulie, bred by H. F. Hills, of Amherst.

The Jerseys consist of a bull, Essex, from the herd of Charles G. Loring, of Boston; a bull calf, Enterprise, bred by James

Thompson, of Nantucket; and a cow, Lucy, from the stock of Henry Cobb, of Amherst.

Besides the above-named, thoroughbred animals, the College has about forty natives, mostly cows, and steers designed for slaughter. There are also upon the farm twenty-five fine Southdown sheep, from the stock of Thomas Buffum, of Newport, R. I., and twenty-four swine of the Suffolk, Berkshire and Chester County breeds.

The teams consist of two pairs of oxen and five horses.

Since the first of June, Capt. A. J. Marks has had the immediate oversight of the business in this department, and has managed it in an efficient and faithful manner.

The theoretical and practical instruction in agriculture has been in charge, as heretofore, of Prof. Levi Stockbridge, who has devoted himself zealously and successfully to this work. His labors have been supplemented by a course of lectures on dairy farming, by Charles L. Flint, A. M., and another on market gardening, by Jabez Fisher, M. D.

More than $20,000 have been expended during the past season for permanent improvements in the agricultural department, by which the facilities for instruction have been greatly increased. It is intended to develop the professional character of the College as completely and rapidly as possible, and so to command the attention, the respect, and the patronage of those for whose particular benefit it has been founded.

Board of Overseers.

The Board of Agriculture visited the institution in August last, and their committee, consisting of Messrs. Agassiz, Thatcher and Slade, have attended the examinations at the close of each term. The interest in agricultural education thus manifested by the representatives of the various societies cannot fail to exert a stimulating influence upon both the faculty and students of the institution and the farmers of the Commonwealth.

Aid for Indigent Students.

In accordance with the recommendation of the Board, nearly all of the thirty societies in the State have established one or more scholarships, the advantages of which are enjoyed by

students selected from their respective limits by committees appointed for the purpose.

In addition to this, Hon. Albert Fearing, William Knowlton, Esq., and Dr. Nathan Durfee, members of the Board, have liberally contributed to the maintenance of indigent students. Francis Dane, Esq., of Boston, has also paid into the treasury one hundred dollars, to be used by the president for the same purpose.

It is most desirable that assistance be rendered, in some way, to the large number of worthy young men who are striving to secure an education at the College with very limited means. This may be done by founding free scholarships, by the payment into the treasury of $1,000 for each; by establishing a loan fund, from which students might borrow such small sums as, from time to time, might be necessary to enable them to remain in College; or by the gift to the institution of money, the income of which should be expended in the form of liberal wages for manual labor. This last method would be doubly useful in supplying the farm with necessary help, and in enabling students to work their way through College, and thus, while obtaining a good education, form habits of industry and self-reliance.

New England Agricultural Society.

The second national exhibition of agricultural machines, instituted by the New England Society, was opened at the College June 20th, and continued four days. During this time, twenty-five mowing machines, twelve horse-rakes, three tedders and a hay-loader were critically examined and severely tested in the field by competent committees. The occasion brought together a large number of inventors, manufacturers and agents, as well as farmers, from different parts of the country, and resulted in much good. The perfection of the mowing machines was quite remarkable, and the differences in actual merit between several of the best patterns was scarcely appreciable. In amount of draft, in simplicity and strength of construction, in convenience of operating, in quality and quantity of work performed, and in cost, there was a surprising uniformity.

It is a singular fact, which shows the progress of invention,

that of the four machines exhibited at a trial on the same farm ten years before, not one was in any form offered for inspection.

The students were deeply interested, and acquired such knowledge of the construction and merits of the various machines presented, and of the proper methods of subjecting them to thorough trial, as they could have obtained in no other way.

Horticultural Department.

The botanic museum has been enriched by the generous gift of $2,000, from William Knowlton, Esq., of Upton, a member of the Board of Agriculture, for the purchase of an herbarium and the erection of suitable cases for its safe keeping.

The herbarium was collected by Mr. W. W. Denslow, of New York, and contains about fifteen thousand species of plants from various countries. It is well supplied with the plants which occur in the United States and in Europe. About ten thousand species are admirably mounted on thick, white paper, and the remainder are mostly named and ready for mounting. A catalogue is now preparing for the press.

In addition to the Denslow collection, six hundred species, mostly from the Rocky Mountains, have been purchased of Dr. George Vasey, botanist of Powell's Colorado expedition; also, a beautiful herbarium of cryptogamous plants from Germany.

A very curious and interesting suite of fifty specimens from the Himalaya Mountains has been received from the celebrated travelers, the brothers Von Schlagentwelt. These consist of sections of the trunks of trees varying in diameter from six inches to two feet. They are sawed from logs with the bark on, and are about two inches thick. One surface is polished and waxed, so as to exhibit the color and structure of the bark, the sap and the heart-wood. Each specimen is bound with iron, and so mounted that it can either be hung on the wall or caused to stand at any desired inclination upon a shelf.

Additions have also been made by members of the College to the specimens of indigenous woods and seeds in the museum, and the fruit models received from the Massachusetts Horticultural Society have been repainted.

There have been obtained from Germany several volumes of very old, botanical books, profusely illustrated with wood-cuts of the plants described. Among them is a work by Otto Brun-

felsius, printed in 1530; another by Tabernæmontanus, published in 1590; and a third by Rovillius, published at Venice in 1587. This consists of two, immense, quarto volumes of two thousand pages, and is a general history of all plants described up to that time. It is written in Latin, and the index gives the names of the plants, so far as known, in Latin, Greek, Arabic, French, Italian, Spanish, German, Bohemian, Belgian and English.

The sash doors and cornice for the cases of the Knowlton herbarium are of chestnut, trimmed with black walnut. The shelves are of Spanish cedar, half an inch thick, and their size is eighteen by twelve inches. They are slipped loosely into grooves five inches apart, forming altogether two hundred and forty pigeon-holes of just the right size to receive the paper on which the plants are mounted. In these the different orders and sub-orders are deposited according to the arrangement of Jussieu, and the printed name of the order is pasted on the inside of the glass directly in front, so as to be legible from the outside. Underneath these cases are cupboards for duplicates, paper and labels, and the whole will contain thirty thousand species.

The interest of the students in the study of botany has been greatly increased by this admirable herbarium, and they have been unusually successful in the search for rare plants during the past season.

The Durfee plant-house has been filled with specimens of about one thousand species of such plants as are most important in a scientific or an economical point of view. Among these may be named sugar-cane, banana, pine-apple, coffee, black and green tea, vanilla, black pepper, cinnamon, cassia, camphor, grenadilla, guava, pomegranate, fig, orange, lemon, olive, banyan, India-rubber, date palm, and most of the plants cultivated for their beauty of flower or foliage.

The Victoria regia is growing in its tank of warm water, but has not yet blossomed, and along with it is the charming, blue water-lily, which flowers continually.

A superb specimen of the Cyanophyllum magnificum was grown in the Victoria house, which received a silver medal at the exhibition of the Massachusetts Horticultural Society in Boston. Through the politeness of the president, J. F. C.

Hyde, Esq., the members of the College were invited to attend the exhibition of the Society in September, and fifty students gladly availed themselves of the opportunity to visit both the Horticultural Exhibition and the Mechanics' Fair, to which they were also admitted gratuitously.

A delightful drive has been opened from the plant-house to the new residence of the president on Mount Pleasant; the grounds designed for ornamental planting have been cleared of many worthless trees, stumps, and stones; and ten acres have been sown with grass. A working plan is now in preparation for the laying out and planting of the botanic garden and arboretum, which should be commenced at the earliest practicable date.

The nursery of ornamental trees and shrubs has been largely increased by the purchase and planting of small stock, and will furnish a valuable supply whenever wanted.

Of fruit trees there have been set the past season two hundred and fifty standard pears, the gift of Hon. Marshall P. Wilder, fifty peaches, and twenty-five apples. Fifty apple-trees presented by Asa Clement, Esq., and forwarded by railroad, were never received.

There have also been planted two thousand grape-vines, including ten of the best sorts, but the greater part are Concords. They were set six feet apart, in rows nine feet apart, and staked with chestnut pickets five feet long. The design is to support them in 1871 by wire trellises. The vineyard is a gravelly loam, sloping to the south, sheltered by trees on the north, and elevated nearly three hundred feet above the river, which greatly diminishes the danger from frost.

The garden for small fruits and vegetables has been placed under charge of the farm superintendent, and several acres of ground have been selected and heavily manured for planting in the spring. Currants, raspberries, strawberries, asparagus and rhubarb, were set last spring, and the supply will be increased next season.

It is proposed also to institute a series of experiments with the sugar beet for the purpose of determining what varieties are best suited to our soil and climate, and what per cent. of sugar may be expected from them. It would seem that an industry which has developed so rapidly and prosperously in Europe, with such beneficial results to agriculture, could hardly fail of being remunerative here.

A reservoir has been constructed on the hill south-east of the plant-house, and 2,100 feet of four-inch pipe laid from it in a westerly direction to the central ridge. From this point a two-inch iron pipe is laid southerly to the new barn and farm-house, furnishing an abundant supply of soft, running water. Whenever funds can be spared for the purpose, it is designed to lay about 2,500 feet more of two-inch pipe in a northerly direction along the front of the College buildings and boarding-houses to the north barns, and to supply them all with water by means of service-pipes.

The cost of building the reservoir and laying the pipes, with hydrants and gate, was $2,000.

The work was promptly and faithfully executed by Mr. Geo. L. Manchester of Easthampton.

Buildings.

The buildings represented in the frontispiece of the Report are the following, viz.:—In the foreground is the Durfee Plant-house as it will appear on the front when completed according to the design; near by, and a little to the rear, is the Botanic Museum; on the extreme left is South College; next to it, one hundred feet distant, is North College; the central building is the new College Hall just finished; north of this, and separated from it by a deep ravine, are the boarding-houses.

College Hall is a large, wooden edifice with a width on the front of sixty feet, and a length of ninety-seven feet. The basement is nine feet high in the clear, and contains a room for furnace and coal, a repair shop, and a chemical work-room and store-room. The first story is fifteen feet high, and includes a chapel sixty by forty feet, and four rooms occupied by students in practical chemistry. The second story is of the same height, and consists of the hall for drawing, which is also used as a recitation and lecture room by the professor of mathematics and engineering; a chemical lecture-room, and the office, private laboratory and apparatus room of the professor of chemistry. The third story in the Mansard roof is twenty-three feet from the floor to the upper rafters, which are planed and painted. Here is the military hall, about one hundred feet by fifty, and the armory, forty feet long by twelve wide. The cost of College Hall, with permanent furniture and grading, will

be about $20,000. The cost of the chemical laboratory which is now incorporated in the new edifice, was about $10,000, making the entire cost of the building $30,000.

The architect was Mr. George Hathorne, of New York, and the builder, Mr. C. W. Lessey, of Amherst.

All the buildings of the corporation are insured against loss by fire in the aggregate sum of $84,900, for five years, from the dates of the several policies.

Course of Study and Instruction.

The legislature of 1863 having decided to establish an independent institution for the education of farmers and the promotion of agriculture, evidently intended that it should afford instruction in the higher branches of learning. It was chartered as a *College*, which in Massachusetts means something, and the large sum of $75,000 was demanded as the price for which the advantages resulting from its location in any community were to be secured. The trustees accordingly, with entire unanimity, adopted a very liberal and comprehensive plan of organization, which was approved by the governor and council, and has been steadfastly adhered to in all subsequent operations.

The complete course of study occupies four years, and is arranged with special reference to the wants of young men who design to be practical farmers or gardeners.

While it is the purpose of the faculty to give the best possible instruction upon every subject taught, there is no desire to expand the course beyond the proper limits of a simple professional school, or to compete in any manner with other existing institutions. The College is intended, however, to be very different from a mere manual labor or farm school for training apprentices in the various operations of husbandry. As an experimental station for the advancement of agricultural science in general it will doubtless accomplish something of importance; and ultimately the estate may be expected to serve as a model in many respects for the farms of the Commonwealth.

When the College is fully established, all the instruction of the complete curriculum will be repeated every year, and students will be allowed to select and pursue any studies taught, remaining for a single term or longer, as they please. This plan

enables those who from lack of time or funds are unable to enjoy all the privileges of the institution, to obtain at least as much benefit as they could from one of a lower grade, or with a shorter course. It is an encouraging fact that nearly all the present members of the College are in the regular classes.

Recognizing the fact that good health lies at the foundation of the highest happiness and efficiency of every person, the education begins with the study of human anatomy and physiology, accompanied by lectures upon hygiene. By means of diagrams, a skeleton, and a manikin of life-size, the structure, position, and use of every organ is illustrated. The more common injuries, resulting from accident, disease, bad modes of living, or excessive indulgence of appetites or passions, are pointed out, and the proper remedies suggested. Commencing with the theoretical instruction, and continuing through the entire course, is a system of muscular training connected with manual labor, light gymnastics, military drill, and scientific excursions, which can scarcely fail to develop a vigorous and manly form, an erect and graceful carriage of person, and a thoroughly sound body.

The act of Congress granting lands to the different States for the endowment of agricultural colleges requires that military tactics should constitute a part of the course of instruction. Believing that the training of a large number of her intelligent young men in all that pertains to the use of the rifle, the bayonet, the sabre, the cannon, and the duties of soldiers and officers in the different branches of service in the field, together with a knowledge of the construction of fortifications, would be of immense value to the Commonwealth, and that military drill is a most admirable means of physical culture, the College has made ample provision for this department. A convenient armory and a spacious hall have been erected; the State has furnished arms and equipments; and the United States supports at the College an accomplished officer of the regular army, who is a member of the faculty, and has entire charge of this department.

The military drill in the hall is, to a great extent, substituted for manual labor in the field during stormy weather and the winter season. Thus regular exercise is secured to all students every day of the college year, which is of very decided advantage to their health. The arrangements for this department

are so excellent and complete that it can hardly fail to be popular, efficient and useful.

All students of the regular classes, unless physically incapacitated, are obliged to work upon the farm without compensation six hours each week whenever called upon to do so. They are also allowed to labor for wages, varying from ten to twenty cents per hour, according to the value of their services, as much as they please, provided their studies are not neglected.

The intention of the system of compulsory, manual labor is altogether educational, precisely like the manipulations of the chemical laboratory, or the hospital practice of the medical student. Farmers' sons are supposed to have been already trained at home, and to need only instruction in the most improved methods of performing their work and the principles involved in it. Those who have never engaged in farm labor can only be taught the correct theory of the various operations of agriculture, and must perfect themselves by practice in after-life, just as the graduate of the medical school, by wearisome years of toil, becomes the experienced and successful physician. Long practice only can develop the skillful farmer, and the hours of student life can be much more profitably employed than in mere manual labor, opportunities for which are everywhere presented, while the facilities for education are offered only at the College and for a limited period.

Some persons appear to look upon the contented performance of coarse and difficult manual labor with a sort of respect, and to regard with suspicion any attempt to avoid or relieve it as indicative of laziness. But a desire for improvement lies at the foundation of all progress in the arts, and by the intelligent efforts of men, dissatisfied with the methods of the past, agriculture is rapidly rising toward the dignity and physical comfort of a learned profession. How much more mind and how much less muscle is now called into requisition in the various operations of husbandry than twenty-five years ago. In preparing the soil, in planting, in cultivating, in haying, in harvesting, in threshing, in the management of the dairy; in fact, almost everywhere, intelligence is the principal thing, and mere brute force comparatively worthless. The old prejudice against thoughtful, studious and progressive men, as book-farmers and fancy farmers, has at length been overcome by the mass of

printed matter which pours its light into every household, and by the numberless improvements which have been demonstrated to be not merely expensive luxuries for the rich, but of priceless value to every tiller of the soil.

The second department of education in the College has for its object the inculcation of correct ethical and religious principles and the formation of good habits. For this purpose, the Bible is adopted as an invaluable text-book, and its teachings regarded as constituting the best rules for the conduct of life. Morning devotions are held in the chapel every day. A sermon is preached every Sunday forenoon, and a Bible-class held every Sabbath afternoon. The students have organized a Christian Union, and have a room furnished with religious books and papers. Moral science is also made a daily study during one term of the four years' course.

Regularity and promptness in attendance upon any assigned exercise, fidelity and thoroughness in the performance of every duty, and gentlemanly conduct toward all persons are demanded of every member of the institution. Removed as the students are from the temptations of large towns and cities, constantly occupied upon a farm, a mile away from any village, constituting a community of themselves, and living in a very plain and economical manner, it is to be hoped they may avoid many of the evils and extravagances of life in the older colleges, and acquire that simplicity of manners, purity of morals, and true nobility of character, which are so becoming to every man, but especially to the farmer.

The third department of the college course relates to the intellectual training and the literary and scientific instruction of the student. The object is to develop the mental faculties by thorough discipline, to strengthen the memory, to sharpen the powers of perception and analysis, to give facility of expression with the voice and the pen, and to impart that knowledge which will be most useful in practical life. The course in language and literature begins with reading, spelling and penmanship for those who are not already accomplished in these fundamental branches, since many young men of good scholarship in other respects are deficient here. Excellent instruction in elocution is given, with drill in vocal gymnastics, that all may be able to read aloud or to speak in public with distinct

utterance, correct inflections, and effective gestures. Exercises in English composition, in French and German translation, in extempore debate and original declamation are prescribed for the several terms of the curriculum. The French and German languages, the English language and literature, and rhetoric complete the studies of this division.

In addition to this, the Washington Irving Society, maintained by the students, affords abundant opportunity for further development in this direction.

The mathematical studies begin with commercial arithmetic and bookkeeping, and are followed by just so much algebra, geometry, conic sections and trigonometry as are essential to the practical operations of drawing, surveying and leveling, of landscape gardening and military fortification, and the construction of roads, bridges, and farm buildings. Sufficient office and field work is given during the four years to render every student a good surveyor and draughtsman, and, for all agricultural purposes, a competent engineer.

The various branches of physics are taken up in course and illustrated by seventy lectures, and special attention is paid to the construction of agricultural machinery.

Astronomy and meteorology, or the science which treats of those atmospheric phenomena constituting the weather, are also important subjects for consideration.

The study of the great forces of nature, which are so intimately connected, and which produce the infinite variety of changes in the forms and qualities of matter constantly occurring within and around us, is begun the first term and continued for three years. The heat, light, and chemical force, which exist united mysteriously in sunshine, are the powers upon which agriculture is especially dependent. In the mass of the earth sunshine produces electricity and magnetism; in the atmosphere, those currents which mix and temper the constituents of the air, and furnish a most valuable motive power; while from the ocean it raises, in the form of invisible vapor, the moisture which, descending as dew, rain, or snow, refreshes vegetation, feeds the springs and streams, or clothes the earth in its wintry mantle. This process of evaporation also unites the elements of ammonia to furnish this indispensable stimulus of plant growth, while the watery vapor in the air around and

above us shuts in, like the glass of a plant-house, the obscure heat of the earth, which would otherwise be radiated into space so rapidly as to render the climate of Massachusetts uninhabitable. Living beings also are dependent for health and vigor upon the influence of sunshine. To understand what sunshine *is* and *does* is therefore essential to intelligent, scientific agriculture.

After spending two terms in the study of these forces and witnessing in the experiments of the chemical lecture-room the illustrations of their peculiar effects upon matter and upon each other, the student enters the laboratory and becomes a practical chemist. After one year's close application he may be qualified to understand and explain most of the chemical changes of importance to the farmer, and to make, with correctness, experiments and investigations in regard to the composition of soils, manures, and the various products of the earth. He has become at least master of the means to be employed in scientific inquiry, and is familiar with the use of books, reagents and apparatus ;—he has the key to the door of knowledge.

The agricultural bearings of chemistry are so numerous and important that they cannot be named in detail here. Not only is a knowledge of its principles indispensable to an understanding of the out-door operations of agriculture, but in the feeding of animals, in the making of cheese and butter, in the preservation and ripening of fruit, in preventing the decay of vegetables, fruits and fresh meats by desiccation, by canning, or the direct use of antiseptics, the aid of the mystic art is everywhere needed.

The science of botany teaches the student the structure of plants, their mode of growth, their various forms and names, and their useful or injurious properties. In its applications to agriculture, it reveals the diseases of vegetation and often their causes and remedies ; unfolds the reasons for many of the processes of the horticulturist, such as hybridization and artificial fertilization, and the numerous modes of propagating by extension and by seed ; explains how plants feed and grow, and are improved for special purposes ; and tells the origin and habits of cultivated plants and weeds. Botanical knowledge requires no costly apparatus, is easily acquired, and is of great value to the farmer.

Zoölogy treats of animal life, and is a science of the utmost interest, but of vast extent and difficulty. The general system of classification in this great kingdom of nature, and the natural history of the more common animals, with some knowledge of their comparative structure, should be familiar to every well-educated person. The zoölogist in applying his knowledge to agriculture, would, as an entomologist, discourse of useful insects, like the silk-worm and the honey-bee, their habits, diseases, and proper treatment under the varying circumstances of their existence; or he would point out the injurious insects, the borers, caterpillars and beetles, and inform us what to do for protection against their depredations. As an ichthyologist, he would reveal the mysteries of the new branch of farming, the breeding of fish; and as an ornithologist, he would give us an insight into the structure and habits of domestic and other birds. He should also teach the history and peculiarities of the different breeds of mammals, which have resulted from domestication, and the principles by which varieties are to be produced or preserved.

But the study of the diseases of the animals of the farm and their proper treatment is a subject of the highest moment, and the practical application of this knowledge constitutes the veterinary art. It is intended that the students of the College shall be thoroughly instructed in this art which is at the present time almost unknown in this country. A vast amount of property in live stock is lost every year from the want of information in the community on this subject. The ordinary horse and cow-doctors of Massachusetts are not distinguished for their learning or their skill, and should be replaced as soon as possible by men of science.

The study of physical geography and geology will enable the student to contemplate the structure of the globe, both internal and external, and to learn how it has been preparing through countless ages to be the abode of man. In their applications to agriculture they will teach the origin of soils, and the causes which in various countries affect the fertility and products of the earth and the character of its climate and inhabitants.

In conclusion, the intellectual and scientific division of the college course includes the study of mental philosophy, history,

the civil polity of the state and national governments, and political economy. These subjects demand the careful attention of every person who would be well informed in regard to his own faculties, and his duties as a citizen of a free republic.

The last and most important department of the College,—that for which it was founded, and by the character of which it must be judged, is the Agricultural. It must sustain a high reputation as an educational institution, but that is not enough. Its graduates must not only be vigorous, virtuous and intelligent men, but they must be good farmers and gardeners, at least in theory. They must know the origin and nature of soils and sub-soils, and the proper treatment for each; the methods and advantages of the various kinds of tillage; and the modes of drainage and irrigation, with their cost and value. They must understand the worth and peculiar effect of every variety of mineral and organic fertilizers; the construction and use of all the implements and machines of improved husbandry; the best modes of planting, cultivating, and harvesting all sorts of crops, and the varieties of each which are most valuable for different localities and objects. They must be familiar with the characteristics of the different breeds of domestic animals, and their various adaptations; with the proper modes of feeding for particular purposes, and of treatment in health and sickness, and with the principles of breeding. They must be acquainted with the keeping of farm accounts, the ordinary rules of business, and the legal rights and obligations of land-holders; with the renovation of worn-out lands, and the improvement of those which are new and rough; with the most desirable location and construction of farm buildings, the correct division of an estate into arable, pasture, meadow and wood-land, according to circumstances, and the building of roads, bridges and fences. They must understand the use of rotation in crops; the management of the dairy; the cultivation of vegetables in the market garden and under glass; the raising of small fruits, and their transportation and sale; the planting and culture of vineyards, orchards, and forest trees; and the theory and practice of landscape gardening, with the proper selection and treatment of ornamental plants.

No complete system of agricultural science has yet been per-

fected, and intelligent men differ widely in opinion upon many of the most important questions which it involves. Nevertheless, order is gradually evolving from the chaos of the past and accurate experiment and observation are harmonizing conflicting views. The necessity of adopting some definite course of instruction in the agricultural colleges, now springing up in all parts of the country, will compel their professors to diligent research until the wheat of positive knowledge is separated from the chaff of mere opinion. Some text-books have already appeared containing much valuable information in a convenient form for reference, and others are preparing.

The instruction in agriculture and horticulture not only necessitates the consideration of an immense number of topics in the lecture-room, but demands an extraordinary amount and variety of means for its illustration, and practical application.

To provide a model farm with a suitable diversity of soil, aspect and elevation, furnished with buildings of the most approved construction, with all the modern, agricultural implements and machines, and the choicest specimens of the best breeds of animals, is a work requiring years of effort, and a very large expenditure of money. The proper management of such an establishment for purposes of instruction and experiment must also be very expensive, as the labor must be performed by young men in process of education and most of the time occupied with their studies.

The arrangement and care of the plant-houses, the museums, and the botanic garden, arboretum, and nursery also add largely to the cost of the establishment, but they are absolutely necessary as means of instruction and investigation. When it is remembered that dormitories, boarding-houses, public rooms, scientific apparatus, books and periodicals, are also necessities, it will not be surprising that the institution must have for its equipment and endowment a large amount of money.

Upon the present plan of organization, with the necessary buildings, the College could accommodate three hundred students, and graduate from its regular course fifty each year. This is an average of about four to each county, and in seven years the number would equal the number of towns in the State. Thus the influence of the institution would be widely and speedily

felt upon our husbandry. The graduates will not only accomplish much good by their example as farmers, but they will constitute a body of trustworthy observers and intelligent experimenters who in different portions of the Commonwealth will zealously coöperate with the College and the societies in advancing the interests of agriculture. Some of them will be needed as editors and teachers, and it is to be hoped they may soon start at least one agricultural school in each county, for the education of those who cannot enjoy the larger advantages of the College. Wherever they are, and whatever their business, they will know what are the best books and periodicals for the farmer's library and how to use them to the best advantage; they will be agitators for improvement and excellent advisers of the community in which they reside. They will be able to give information in regard to the supposed mines and mineral springs which are so frequently discovered; to detect the humbug usually concealed in the low-priced, but, as claimed, wonderfully potent fertilizers annually offered for sale; to show wherein newly invented, agricultural machines are valuable or otherwise; to recommend the best methods for improving swamps and other lands; to aid in leveling, surveying, and farm engineering generally; to give advice respecting varieties of seeds, fruits and stock, and especially to act the part of veterinary surgeons in the case of accident or disease to any animal of much value. Generally this help can be rendered without much expenditure of time or labor and, therefore, gratuitously, and so the graduates of the College will do something to pay the debt they owe the Commonwealth for their education.

Conclusion.

The College was opened for students October 2d, 1867. The number in attendance in 1868 was ninety-six, and in 1869 it increased to one hundred and nineteen.

The farm contains 384 acres, and is well provided with buildings, stock, and implements. The total expenditure for real estate, improvements and apparatus for instruction has been about $225,000, and the cash fund for the maintenance of the institution is about $150,000. In order to accommodate the four regular classes and the special students, together with the

officers of the faculty, additional buildings will be necessary, the cost of which will vary from $100,000 to $200,000, according to the number provided for. As every student pays term bills to the amount of $54 per annum, it is obviously good economy to assemble as many as can be taught to advantage, which is about three hundred. With this number the expenses of instruction will be but little more than for one hundred ; the farm labor will be more abundant, and the beneficial influence and financial ability of the College greatly enhanced. Every effort is made to reduce the cost of living so as to enable young men of limited means to avail themselves of the advantages of education. The absolutely necessary cost of a residence at the institution will not exceed $250 per annum, including all expenses except clothing.

The Massachusetts Agricultural College should be furnished with whatever is necessary to render it equal to the best in the country. Wise public policy demands that all reasonable effort at agricultural improvement should be encouraged. The annual value of the farm produce of the State is more than $69,000,000, or $1,000 for each person employed in the business of farming. It is many millions more than it would have been, but for the establishment of the agricultural societies and the Board of Agriculture.

If the College coöperating with all other agencies, as societies, clubs, schools, and agricultural books and periodicals, should be instrumental in the production of one per cent. more of value from the farms of the Commonwealth without any increase of cost, it would add annually to our wealth $690,000. If we consider for a moment what the applications of science have done for manufactures and commerce, or even what they have done for agriculture, we cannot fail to anticipate a far grander result than this, satisfactory as this ought to be in a mere pecuniary point of view.

In England, by the adoption of the best methods of improving and managing an estate, its annual rental has been raised, within thirty years, from $25,000 to $200,000, and the average product per acre of wheat in Great Britain has been more than doubled during the present century.

In Prussia, there has been a remarkable development during

the last few years in rural affairs. The soil has been enriched, the domestic animals greatly improved and multiplied, and the annual farm produce largely increased in value. In no other country at the present time is agricultural education so highly advanced and so generally diffused. There are four royal agricultural societies, and more than five hundred voluntary agricultural organizations for the advancement of the art. There are nineteen professional agricultural schools aided by the government, and several experimental stations for the special study and application of agricultural chemistry, besides a large number of schools devoted to the training of young farmers for some particular branch of their business. In addition to all this, suitable persons are employed to go from village to village criticising the prevailing cultivation and farm management, and imparting valuable practical information upon agricultural topics. As the general intelligence and thorough training of her soldiers enabled Prussia to win with astounding rapidity glorious victories in her late war with Austria, so the education and skill of her farmers will furnish her the material wealth essential to the maintenance of her proud position.

With such results of agricultural education before her, Massachusetts cannot hesitate in completing the establishment of the College, which has been so auspiciously commenced. A detailed statement was made to the legislature of 1868 respecting the amount needed to provide for the accommodation and instruction of the four classes. The committee to whom the matter was referred unanimously reported a bill granting $150,000, to be paid in three annual installments, upon condition that $50,000 be secured from other sources. But the legislature preferred to appropriate unconditionally the sum of $50,000, which has been expended so as to meet the most pressing necessities of the institution, in the confident expectation that the remaining sum of $100,000 would be granted as required.

In order to receive another class next September a new dormitory must be erected, as the present buildings are full. Three dwelling-houses for professors are almost indispensable, as their presence on the premises is very desirable, and suitable tenements in the vicinity cannot be rented. Funds are also needed for books, apparatus, and farm improvements. True economy

demands that the neccssary buildings, which the State is pledged to provide, should be supplied as rapidly as they can be filled with students, so as to secure for the institution the greatest available income, popularity, and usefulness.

Finally, believing that the wisest statesmanship will be most watchful of the interests of agriculture, the foundation of all human industry, we earnestly recommend to your favorable consideration the Massachusetts Agricultural College.

Respectfully submitted,
By order of the Trustees,

W. S. CLARK, *President.*

AMHERST, Jan. 1st, 1870.

CATALOGUE

OF

TRUSTEES, OVERSEERS, FACULTY AND STUDENTS,

1869.

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Lecturer on Comparative Anatomy.

HON. MARSHALL P. WILDER,
Lecturer on the Culture of Fruits and Flowers, and the Art of Producing New and Valuable Varieties.

A. S. PACKARD, JR., M.D.,
Lecturer on Useful and Injurious Insects.

PROF. E. S. SNELL, LL.D.,
Lecturer on Physics.

GEORGE B. LORING, M.D.,
Lecturer on Stock Farming.

PROF. L. CLARK SEELYE,
Lecturer on English Literature.

JOHN GRIFFIN, GARDENER.

CAPT. A. J. MARKS, ACTING FARM SUPERINTENDENT.

Junior Class.

Allen, Gideon Hammond,	Marion.
Bassett, Andrew Lewis,	Amherst.
Birnie, William Perkins,	Springfield.
Bowker, William Henry,	Phillipston.
Brown, Clarence Eaton,	Florence.
Breck, Webster,	Watertown.
Caswell, Lilley Brewer,	Fitchburg.
Cary, William Hubert,	Amherst.
Cowles, Homer Lucian,	Hadley.
Eastman, George Henry,	Amherst.
Ellsworth, Emory Alexander,	Barre.
Fisher, Jabez Franklin,	Fitchburg.
Fuller, George Elwyn,	Amherst.
Greene, William Henry,	Hadley.
Hawley, Frank Warren,	Hadley.
Herrick, Frederick St. Clair,	Lawrence.
Leonard, George,	New Bedford.
Lyman, Robert Worthington,	Easthampton.
Morse, James Henry,	Salem.
Nichols, Lewis Abel,	Danvers.
Norcross, Arthur Dickinson,	Monson.
Page, Joel Bardwell,	Conway.
Richmond, Samuel Howard,	Taunton.
Russell, William Delano,	Sunderland.
Swift, George Albert,	Charlestown.
Smead, Edwin,	Greenfield.
Southwick, Alonzo Lewis,	Blackstone.
Sparrow, Lewis Addison,	Medway.
Strickland, George Porter,	Amesbury.
Thompson, Edgar Eliab,	Hopkinton.
Tucker, George Homer,	W. Spring Creek, Pa.
Ware, Willard Carroll,	Salem.
Wheeler, William,	Concord.
Whitney, Frank LePrelet,	Boston.
Woolson, George Clark,	Hopkinton.
Total,	35

Sophomore Class.

Ames, William Campbell,	Conway.
Barber, Strong Hayden,	Windsor, Conn.
Bell, Burleigh Cook,	Winchester.
Blood, Alonzo Hutchinson,	Winchester.
Brainard, John Wilson,	Palmer.
Brett, William Franklin,	North Bridgewater.
Barker, Charles Augustus, Jr.,	Charlestown.
Bullard, William Ebenezer,	Royalston.
Clark, John Wesley,	Hadley.
Cole, Daniel Pomeroy,	Springfield.
Cowles, Walter Dickinson,	Amherst.
Cowls, Frank Colton,	Amherst.
Chapman, Edward Brown,	Jersey City, N. J.
Crocker, Loring, Jr.,	Barnstable.
Cutter, John Clarence,	Warren.
Dyer, Edward Norris,	Shrewsbury.
Easterbrook, Isaac Henry,	Boston.
Fisk, Edward Ransom,	Amherst.
Flagg, Charles Otis,	Westminster.
Grover, Richard Baxter,	Amherst.
Harrington, Frank Warner,	Amherst.
Holmes, Lemuel Le Baron,	Mattapoisett.
Kimball, Francis Elliot,	Dudley.
Lester, Frank Harris,	Plainfield, Conn.
Livermore, Russell Woolcott,	Bozrahville, Conn.
Lockey, John Morse,	Leominster.
Mackie, George,	New Bedford.
Maynard, Samuel Taylor,	Northborough.
Morey, Hubert Ellis,	Malden.
Nash, Arthur Henry,	Hadley.
Ober, Frederick Albion,	Beverly.
Peabody, William Russell,	Boston.
Penhallow, Charles Lowell,	Portsmouth, N. H.
Salisbury, Frank Battelle,	Sherborn.
Shaw, Dwight Elliot,	Chicopee.
Snow, George Henry,	Leominster.
Somers, Frederic Maxwell,	Greenfield.
Thomas, George Hutchins,	Lebanon, Conn.
Thompson, Samuel Clarence,	Southborough.
Wells, Henry,	Stockbridge.
Whitney, William Channing,	Harvard.
Total,	41

Freshman Class.

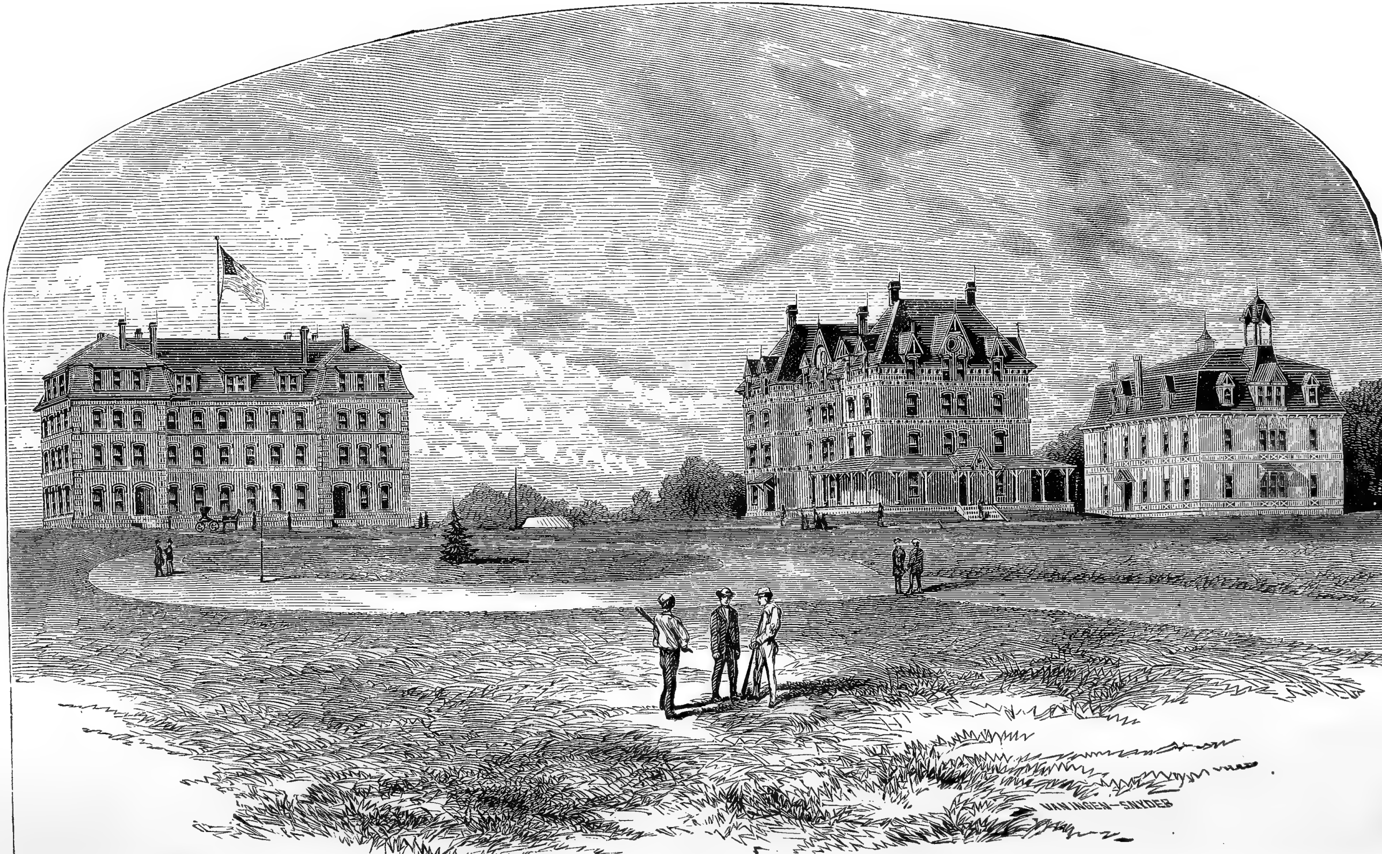
Avery, Frank Rhodes,	Westfield.
Baker, Frederick William,	Winchester.
Barrows, Fletcher Kneeland,	Brattleboro', Vt.
Carter, Herbert Mason,	Winchester.
Childs, William Frederick,	Montreal, Canada.
Copp, Belton Allyn,	Groton, Conn.
Eldred, Frederick Cornelius,	Sandwich.
Flower, Archibald Dick,	Ashfield.
Furness, George Albert,	Tarrytown, N. Y.
Healey, George Clifford,	Hampton Falls, N. H.
Lathrop, Joseph Dwight,	Northampton.
Lovell, Frank Kendall,	Boston.
Leland, Walter Sherman,	Sherborn.
Lyman, Asahel Hubert,	Huntington.
Mills, George Westgate,	Medford.
Mines, William Wales,	Brooklyn, N. Y.
Minor, John Bacon,	New Britain, Conn.
Penhallow, David Pearce,	Portsmouth, N. H.
Renshaw, James Budden,	Richmond.
Rowland, Clarence Warner,	Boston.
Sanderson, Robert Wilson,	Amherst.
Simpson, Henry Bell,	Hudson, N. Y.
Warner, Seth Smith,	Florence.
Warriner, Alfred Allen,	Warren.
Total,	24

Select Class.

Blankinship, Edwin Augustus,	Marion.
Bayley, Jonathan,	Northampton.
Barreto, Fiuza,	Bahia, Brazil.
Capen, Thomas Allyn,	Taunton.
Colby, Daniel Thompson,	Newburyport.
Cook, Charles Montague,	Honolulu, Sandwich I.
Damon, Edward,	Honolulu, Sandwich I.
Dean, Charles Thomas,	Columbus, Ga.
Garrett, William Edward,	West Newton.
Kingman, William Hart.	Amherst.
Luther, Gardner Clark,	Providence, R. I.
Morris, Frederick William,	Springfield.
Phelps, John,	Milo, Ill.
Sanderson, Charles Franklin,	Petersham.
Smith, William Owen,	Koloa, Sandwich I.
Swazey, Walter West,	Springfield.
Vose, Edward Faxon,	Marion.
Wills, John Wheelwright,	Boston.
Wood, Frank Warner,	Grafton.
Total,	19

Summary.

Juniors,	35
Sophomores,	41
Freshmen,	24
Select,	19
	119



MASSACHUSETTS AGRICULTURAL COLLEGE.

COURSE OF STUDY AND INSTRUCTION.

Freshman Year.

First Term.—Recitations in Human Anatomy and Physiology; Chemical Physics; and Commercial Arithmetic and Book-keeping. Lectures on Agriculture: *first*, its importance as an Art, and its relations to other pursuits; *secondly*, as a Profession, and the education it requires; and *thirdly*, of Soils, their origin, varieties and composition. Lectures on the Properties of Matter and the nature and effects of the forces, Heat, Light and Electricity. Lectures on the Laws of Health. Instruction in Elocution; and in Penmanship and Orthography for such as are deficient in these branches. Military Drill: Infantry Tactics; The School of the Soldier.

Second Term.—Recitations in Chemistry; Algebra; and French. Lectures on Agriculture: Improvement of Soils by chemical and mechanical means; Drainage; Irrigation; Tillage; Implements for and methods of stirring and pulverizing the Soil and Subsoil. Lectures on the Chemistry of the Non-metallic Elements; the principles of Chemical Philosophy; the most important Metals and their uses in the arts. Instruction in Elocution; Vocal Music; and English Composition. Military Drill: Infantry Tactics; School of the Company, and Manual of Arms.

Third Term.—Recitations in Algebra and Geometry; and French with written Exercises. Lectures on Agriculture: Sterility of Soils, its Causes and Remedies; Rotation of Crops. Lectures on Organic Chemistry; Instruction in the Laboratory in Analytical Chemistry. Instruction in Elocution and Reading. Military Drill: Infantry Tactics; Schools of the Company and Battalion.

Sophomore Year.

First Term.—Recitations in German; Geology; Geometry and Conic Sections. Lectures on Agriculture: Mineral Fertilizers; Organic Fertilizers; Animal Manure, its origin, varieties, value and treatment; Wastes of Fertilizers; Absorbents of liquid Manures; Composts; Application of Fertilizers. Lectures on Agricultural Chemistry. Instruction in the Laboratory in Practical Chemistry. Exercises in Declamation; and French Translation. Military Drill: Infantry Tactics; Manual of the Bayonet; and Instruction in duty as Skirmishers.

Second Term.—Recitations in German with written Exercises; Logarithms, Plane and Spherical Trigonometry, and Measurement of Lines, Surfaces and Volumes. Lectures on Agriculture: Economy in the treatment and use of Soils, Manures, Crops, Teams, Laborers, Live Stock, Implements, Fences and Buildings. Lectures on Quantitative Analysis, and Practice in the

Chemical Laboratory. Exercises in Declamation; and Vocal Music. Military Drill: Infantry Tactics; Bayonet Exercise.

Third Term.—Recitations in Zoölogy; and Surveying, with Practical Land Surveying, Plotting and Geometrical Drawing. Lectures on Agriculture: Farm Management; Selection of Lands; Division into mowing, arable, pasture and woodland; Roads; Fences; Buildings; System to be adopted; Plans for each year; Cultivation and use of the various crops; Sources of profit in General Farming; Special Farming. Lectures on the Diseases of Domestic Animals: General Pathology; Fevers and Inflammation and their Consequences; Glanders and Farcy; Diseases of Respiratory and Circulatory Organs; Diseases of Digestive Organs; Urinary and Generative Organs; Castration; Parturition, and Rules for assisting parturient animals; Diseases of Udder and Teats; Affections of the Nervous System; of the Eye; the Skin; the Foot; Method of Shoeing; Wounds; Ulcers; Sprains; Diseases of the Bones and Joints; Dislocations and Fractures. Exercises in Reading and Practice in Writing sentences on the blackboard. Military Drill: Infantry Tactics; Skirmish and Battalion Drill; Guard Duty; and Forms of Parade and Review.

Junior Year.

First Term.—Recitations in German; Mechanics of Solids and Liquids; and Physical Geography. Lectures on Agriculture: Market Gardening including Small Fruits. Lectures on Useful and Injurious Insects. Lectures on Mechanics. Instruction in Practical Leveling and Topographical Drawing. Exercises in Reading Shakespeare. Military Drill: Artillery Tactics; School of the Piece.

Second Term.—Recitations in Mechanics of Air and Steam; Sound; Light; Heat; Electricity; Rhetoric; and Structural Botany. Lectures on the Construction and Management of Plant Houses and the Cultivation of Plants under glass. Lectures on Mechanics of Air and Steam; and Sound. Instruction in Free-hand Drawing; Perspective and Shades and Shadows. Exercises in Debate; and Vocal Music. Military Drill: Artillery and Cavalry Tactics; Manual of the Sabre; and School of the Trooper dismounted; Instruction in Heavy Artillery Tactics and Gunnery.

Third Term.—Recitations in Astronomy; Systematic Botany; and History. Lectures on Milch Cows and Dairy Farming. Lectures on Stock Farming and the Breeding of Domestic Animals. Lectures on Comparative Anatomy. Exercises in Debate. Military Drill: Artillery Tactics; School of the Section; Infantry Tactics; Battalion Drill.

Senior Year.

First Term.—Recitations in Mental Philosophy; English Language; and Civil Engineering for the Farm. Lectures on English Literature. Lectures on the Cultivation of Fruits and Flowers, and the Art of producing new varieties. Instruction in Mechanical and Architectural Drawing; and in preparing Working Plans, and Specifications. Exercises in Original Declamation. Military Drill: Cavalry, Artillery and Infantry Tactics; Duty as

Drill Masters and Officers in Infantry and Artillery Drills; Theoretical Instruction in Cavalry Tactics and the Organization and Uses of Cavalry.

Second Term.—Recitations in Moral Philosophy; Political Science and Economy; and Military Science. Lectures on Rural Law, including the Rights and Obligations of Landholders. Lectures on Arboriculture; the Planting and Care of Trees for the production of Fuel, Timber, Fruit or for other purposes. Lectures on Military History; Military Law; and Courts-Martial. Exercises in Original Declamation. Military Drill: Cavalry Tactics; Sabre Exercise.

Third Term.—Recitations in Landscape Gardening; Meteorology; and General Reviews. Lectures on Agricultural Botany. Lectures on Architecture, with special reference to Rural Affairs. Lectures on Mineralogy and Geology. Lectures on Civil Polity. Exercises in Original Declamation. Military Drill: Target Practice; Sword Play; and General Drill.

Practice in the various operations of the Farm and Garden through the Course.

Select Course.

Those who do not intend to pursue the full course, may select from the studies of the first, second or third terms of any year in the curriculum, such instruction as they choose, provided they are qualified for it.

ADMISSION.

Candidates for admission to the Freshman class are examined in writing upon the following subjects: English Grammar, Geography, Arithmetic, and the History of the United States.

Candidates for higher standing are examined as above, and also in the studies gone over by the class to which they may desire admission.

No one can be admitted to the College until he is fifteen years of age; and every student is required to furnish a certificate of good character from his late pastor or teacher, and to give security for the prompt payment of term bills. Tuition and room-rent must be paid in advance, at the beginning of each term; and bills for board, fuel, and washing, at the end of every term.

The regular examination for admission is held at the Botanic Museum, at 9 o'clock, A.M., on the second Thursday of September; but candidates may be examined and admitted at any other time in the year.

Further information may be obtained from President W. S. Clark, Amherst, Mass.

CALENDAR.

The next academic year begins September 8th, 1870, and is divided into three terms:—

The first term begins the second Thursday of September, and continues thirteen weeks.

The second term begins the fourth Thursday of January, and continues thirteen weeks.

The third term begins the first Thursday of May, and continues thirteen weeks.

EXPENSES.

Tuition,	$12 00	per term.
Room rent,	5 00	"
Incidental expenses,	1 00	"
Board,	3 50	per week.
Washing,	50	per dozen.
Expenses of Chemical Laboratory, to students of practical chemistry,	5 00	per term.
Public and private damages, including chemical apparatus,		at cost.
Annual expenses, including books, about	$250 00.	

REMARKS.

The full course of study occupies four years, and those who complete it will receive the degree of Bachelor of Science. Three recitations, or their equivalent in lectures or literary exercises, are assigned for each day, except Saturday and Sunday. Saturday afternoon is devoted to scientific excursions and recreation. On Sacbath morning, all are required to attend church and, in the afternoon, Bible-class; but, in all biblical instruction, the inculcation of denominational views is, as far as practicable, to be avoided.

All students are expected to engage in manual labor six hours per week when required, without compensation, for the purpose of learning the various operations of the farm and garden, and those who wish to perform additional work for wages will be allowed to do so, and receive pay at the rate of from ten to fifteen cents per hour.

The rooms in the dormitory buildings are unfurnished, except with stoves, but furniture may be purchased, at very reasonable rates, either new or second-hand, in Amherst.

Students, wishing to be absent from any assigned duty, are expected to ask permission beforehand, whenever that is practicable, and, in all cases, to present their excuses after an absence, to any officer from whose exercise they may have been absent.

A careful record is kept of the attendance, attainments, and deportment of every student, and sent to his parent or guardian at the close of each term; and only such as are faithful, successful, and gentlemanly, will be allowed to continue members of the College.

Those who pursue a select course will attend recitations and lectures with the regular classes; but persons properly qualified, and desiring special instruction in Chemistry, Civil Engineering, Agriculture, or Horticulture, will be allowed to make private arrangements with the officers having charge of those departments. During the present collegiate year instruction will be given only to the Freshman, Sophomore and Junior classes.

FINANCIAL STATEMENT,

JANUARY 1ST, 1870.

REAL ESTATE.

College Farm and Quarry,	$37,500 00
South College,	36,000 00
North College,	36,000 00
College Hall,	30,000 00
South Boarding-House,	8,000 00
North Boarding-House,	8,000 00
Durfee Plant-House,	12,000 00
Botanic Museum,	5,000 00
South Barn,	10,000 00
Farm House,	4,000 00
Four Dwellings and Barns, purchased with the estate,	10,000 00
Total Real Estate,	$196,500 00

FARM STATEMENT.

Value of Live Stock,	$6,880 00
of Vehicles and Implements,	2,240 00
of Produce on hand,	4,345 00
	$13,465 00

Total credits of Farm, including property inventoried, Jan. 1, 1870, credit for labor performed in grading, &c., and receipts from sales of produce and live stock,	$17,600 13
Total debits of Farm, including property inventoried, Jan. 1, 1869, and all expenditures for live stock, labor, implements, repairs, seed, fertilizers, &c.,	15,033 00
Balance in favor of Farm,	$2,567 13

FUND FOR MAINTENANCE OF COLLEGE.

IN CHARGE OF THE STATE TREASURER.

The total amount received from the sale of the 360,000 acres of land given to Massachusetts, for the endowment of one or more colleges for the promotion of education in agriculture and the mechanic arts, is	$236,307 40
Of this amount, in accordance with the Act of Congress, was expended for a farm, ...	29,778 40

The investments of the fund made by the State Treasurer are as follows:

United States bonds, 5–20's, interest 6 per cent. gold, . .	$50,500 00
" " " 10–40's, " 5 " " . .	30,000 00
Massachusetts bonds, 5 per cent. gold, ...	24,000 00
" " 6 per cent. currency, ...	3,000 00
City of Salem bonds, 6 " "	55,000 00
City of Lynn bonds, 6 " "	25,000 00
Town of Milford bonds, 6 " "	14,200 00
Par value of bonds, ...	$201,700 00
Town of Plymouth, note, ...	6,724 65
Total Fund, ...	$208,424 65
Annual Income of Fund at 6 per cent., ...	$12,505 48

Two-thirds of this is to be paid to the treasurer of the College, and one-third to the treasurer of the Institute of Technology.

Income of College from Fund, ...	$8,336 99
By the conditions of the gift none of the income of the fund derived from the sale of land scrip can be used for the erection or repair of buildings.	
The Hills Fund of $10,000 for the maintenance of the Botanic Garden is in charge of the College treasurer, and at present yields an income of	500 00
Total Income from Funds, ...	$8,836 99

To this sum should be added the receipts of tuition and room-rent, amounting to $51 per annum for each scholar, and the receipts from the sale of the products of the farm and garden.

Dr. MASSACHUSETTS AGRICULTURAL COLLEGE *in account with* NATHAN DURFEE, *Treasurer.* Cr.

1869.			1869.		
Jan. 1,	To balance,	$17,254 80		By contingent fund,	$8,095 68
	income of Hills fund,	500 00		salary account,	11,691 72
March 15,	amount from State treasurer, interest on fund,	4,456 80		board account,	5,672 27
Aug. 1,	appropriation of 1869,	50,000 00		assistant-treasurer's office,	53 76
Oct. 16,	amount from State treasurer, interest on fund,	4,578 72		building fund,	8,192 70
	term bill account,	11,553 38		farm account, and farm implements,	4,386 18
	farm account, sales of produce,	1,840 06		Hills income account,	281 44
	contingent fund,	119 10		term bill account,	2,707 52
				interest account,	1,379 20
				horticultural and botanical department,	146 61
				special appropriation,	722 62
				new barn appropriation,	8,956 65
				new farm house appropriation,	2,156 10
				new college hall appropriation,	16,669 66
				extra instruction account,	768 00
				bills payable—note paid,	7,000 00
				Luhme & Co., paid as per account,	1,887 10
				live stock account,	1,867 00
				water appropriation,	182 75
				balance cash on hand,	7,485 90
		$90,302 86			$90,302 16

BUILDING FUND.

1869.			1869.		
	To paid balance account 1868,	$5,246 58		By appropriation,	$35,975 11
	moving buildings and repairs,	2,946 12			
	on account new barn,	8,956 65			
	on account new farm house,	2,156 10			
	on account new college hall,	16,669 66			
		$35,975 11			$35,975 11

CONTINGENT FUND

1869.			1869.		
	To balance account 1868,	$122 84		By cash,	$119 10
	expenses trustees,	1,012 14		term bill account,	871 36
	printing and advertising,	1,099 90		paid from accounts,	363 34
	insurance, freight, express, &c.,	1,722 96		Luhme & Co.,	1,200 00
	trees, &c.,	300 88		balance from general fund,	7,087 54
	coal,	829 36			
	Luhme & Co., on account,	1,200 00			
	miscellaneous, as per account,	3,353 20			
		$9,641 34			$9,641 34

Respectfully submitted,

NATHAN DURFEE,
Treasurer Massachusetts Agricultural College.

I have examined the Treasurer's accounts and find them correctly stated and accompanied by the proper vouchers.

D. WALDO LINCOLN, *Auditor.*

BOSTON, January 13, 1870.

Total indebtedness,	$25,000 00
Cash on hand,	7,485 90

GIFTS.

The following gifts have been made to the College during the past year:—

From William Knowlton, Esq., of Upton, $2,000, in cash, for the purchase of an herbarium and the construction of cases in the Botanic Museum.

From Francis Dane, Esq., of Boston, $100, in cash, for indigent students.

From Hon. Albert Fearing, of Boston, $100, in cash, for the purchase of books for the Washington Irving Society.

From the Massachusetts Horticultural Society 125 models of apples, pears and other fruits.

From Mrs. Alpheus Hardy, of Boston, models of fruits from India, manufactured by the natives.

From Rev. J. H. Bates, missionary, collection of seeds from Ceylon.

From the Peabody Academy of Science, their publications.

From Rev. J. F. Clark, missionary, varieties of seed wheat and maize, and geological specimens from Bulgaria.

From Prof. George H. Cook, of New Brunswick, N. J., 2 volumes, Geology of New Jersey.

From Hon. Horace Capron, Commissioner of Agriculture, at Washington, many packages of seed wheat, oats, barley and garden seeds and several copies each of the bi-monthly and annual Reports of the Department of Agriculture.

From Hon. E. P. Tileston, of Dorchester, 13 volumes, elegantly bound, Gardener's Magazine.

From Jonathan French, Esq., of Boston, 42 volumes of agricultural books.

From Mrs. Levi Lincoln, of Worcester, 34 volumes of Hovey's Magazine of Horticulture,

From C. A. Wakefield, Esq., of Pittsfield, one corn-planter.

From Wm. H. Lyman, Esq., of Leverett, 250 varieties of flower seeds.

From Edwin Wheeler, Esq., of Concord, 125 Concord grape-vines.

From Capt. J. B. Moore, of Concord, 225 Concord and other grape-vines, grape cuttings, asparagus roots and strawberry plants.

From Augustus Parker, Esq., of Boston, rhubarb roots and strawberry plants.

From Hon. Marshall P. Wilder, of Boston, 250 standard pear-trees, a quantity of hardy, ornamental shrubs, three large orange trees and a magnificent specimen of Stenocarpus Cunninghami; also, 25 volumes horticultural books, valued at $50.

From James Gould, Esq., of Boston, one ton alkaline phosphate.

From J. F. C. Hyde, Esq., of Newton, one barrel Harrison potatoes.

From Augustus Whitman, Esq., of Fitchburg, 1 Shorthorn bull, Mountain Lad.

From Henry Cobb, Esq., of Amherst, 1 Jersey cow, Lucy.

From James Thompson, Esq., of Nantucket, 1 Jersey bull-calf, Enterprise.

From Hon. E. H. Hyde, of Stafford, Conn., 1 Devon bull, Gen. Lyon.

From H. F. Hills, Esq., of Amherst, 1 Ayrshire heifer, Lulie.

From L. S. Stafford, Esq., of North Stafford, Me., the right to use his patent swinging stanchions.

From F. Nishwitz, Esq., of Williamsburg, N. Y., 1 pulverizing harrow.

From Hon. C. L. Flint, of Boston, 200 volumes of agricultural books for distribution to students; and 2 volumes, Grasses of United States.

From Isaac D. Farnsworth, Esq., of Boston, 40 copies of Flint's "Milch Cows and Dairy Farming," for members of Sophomore class.

From Hon. Wm. B. Washburn, of Greenfield, 12 volumes Congressional Documents.

From Hon. Sanford Howard, of Lansing, Mich., 2 volumes, Report of Michigan State Board of Agriculture.

From Prof. C. U. Shepard, Jr., of Charleston, S. C., a fine specimen of Dickson cotton in the boll.

From the Publishers, "The Massachusetts Ploughman," "The New England Farmer," "The Boston Cultivator," "The California Farmer," "The New England Homestead" and "The American Naturalist."

SUMMARY OF METEOROLOGICAL OBSERVATIONS

For the year 1869:

TAKEN AT AMHERST, MASS.,

By Professor E. S. SNELL, LL.D.

Latitude 42° 22′ 17″. Longitude 72° 34′ 30″. Elevation above the sea level, 267 feet.

REMARKS.

The surprising uniformity of climate is clearly seen upon comparing the results of meteorological observations for the year 1869 with the average for thirty years. The mean temperature in Amherst for thirty years is 46.37°, for 1869 it is 46.54°.

The total rain-fall, including melted snow, is, for thirty years, on the average 44.52 inches, and for 1869 it is 53.47 inches.

This excess of nearly 9 inches above the mean was due to the great storm in October, when the rain-fall was about 10 inches more than in October, 1868.

The average depth of snow is 54.2 inches, and for 1869 it is 58.5 inches.

The average amount of cloudiness for thirty years is 51 per cent. of the visible sky, and for 1869 the amount is precisely the same; and this is the result of 1,095 observations made during each year.

The height of barometer is 29.72 inches, and for 1869 it is 29.68 inches.

Even the unstable wind blows with almost the same uniform steadiness. The total amount of air moving during the past ten years from the north-west averages 47 per cent. of all the wind, estimating both the time during which, and the velocity with which, it blew. The amount for 1869 is 51 per cent. From the south-west the average is 18 per cent., and in 1869 it was 15 per cent. From the south-east the amounts are the same—24 per cent.; and from the north-east it averages 10 per cent., and in 1869 was 11 per cent.

The time of blossoming for early spring flowers was as follows in 1869:—

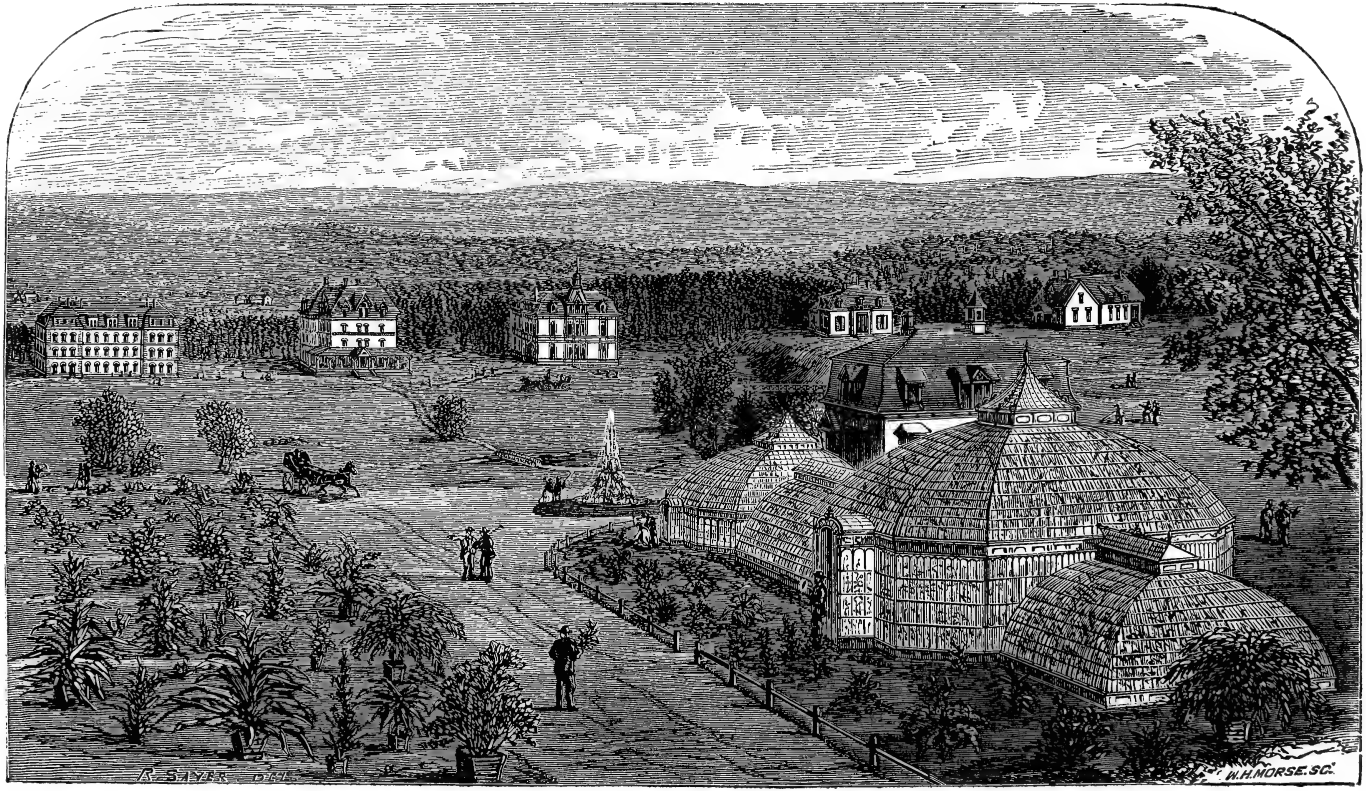
Symplocarpus fœtidus, (skunk's cabbage),	March	14
Viola rotundifolia, (violet),	April	2
Epigæa repens, (trailing arbutus),	"	19
Anemone nemorosa, (wind flower),	May	1
Sanguinaria Canadensis, (blood-root),	"	8
Pyrus Malus, (apple),	"	16

The past season has been remarkably favorable for the oat, about an average for the potato, and rather below the average for Indian corn and hay. The cold, wet weather in May seemed to affect fruit buds unfavorably, but the apples which set adhered to the trees, and ripened a fair crop.

On the whole, the season of 1869 was in many respects similar to that of 1868; but August, the past year, was very dry and clear, and this brought forward the corn rapidly, which otherwise would hardly have ripened. The grape, for the same reason, produced an excellent crop.

SUMMARY OF METEOROLOGICAL OBSERVATIONS FOR 1869.

MONTHS.	THERMOMETER IN THE OPEN AIR.			RAIN AND SNOW.		CLOUDS.	WINDS. TIME AND FORCE.—PER CENT. OF.				BAROMETER. BAROMETER HEIGHT REDUCED TO FREEZING POINT.			FORCE OR PRESSURE OF VAPOR, IN INCHES.			RELATIVE HUMIDITY OR FRACTION OF SATURATION.		
	Maximum.	Minimum.	Mean.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Mean amount of cloudiness.	Northwest.	Southwest.	Southeast.	Northeast.	Maximum.	Minimum.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
January, . .	49.0	3.0	28.04	3.467	16.0	5.3	59	6	22	13	30.095	29.159	29.683	.253	.037	.123	100	39	78
February, .	50.6	-1.0	28.01	4.137	18.5	5.9	58	8	19	15	30.228	28.724	29.618	.214	.041	.117	100	36	72
March, . .	53.8	-9.0	27.28	5.455	14.0	4.8	58	11	15	16	30.229	29.069	29.740	.288	.029	.113	100	35	71
April, . .	74.0	26.7	46.45	1.532	-	4.5	60	14	20	6	30.015	29.125	29.574	.529	.089	.201	92	26	61
May, . .	83.0	35.2	55.87	5.649	0.5	5.7	39	6	34	21	29.936	28.899	29 508	.719	.157	.307	97	26	67
June, . .	80.7	47.4	64.72	5.986	-	5.8	42	32	19	7	30.055	29.240	29.643	.834	.224	.446	98	40	79
July, . .	89.9	53.5	69.08	2.978	-	4.1	47	27	22	4	30.064	29.352	29.667	.822	.269	.533	98	41	77
August, . .	87.2	50.0	66.87	1.037	-	3.8	44	17	30	9	30.137	29.443	29.740	.928	.258	.510	100	34	77
September, .	85.0	36.3	62.06	4.318	-	4.9	28	19	45	8	30.190	29.230	29.887	.871	.193	.475	100	44	81
October, . .	71.4	27.3	46 68	11.358	-	4.8	58	20	21	1	30.113	29.022	29.643	.690	.097	.273	100	36	80
November, .	56.9	16.9	35.92	2.591	-	6.0	56	10	27	7	30.064	29.059	29.649	.349	.079	.159	100	41	72
December, . .	45.3	-7.5	27.48	4.958	9.5	5.8	50	13	20	17	30.367	28.911	29.815	.280	.032	.126	100	38	77
YEAR, . .	89.9	-9.0	46.54	53.466	58.5	5.1	51	15	24	10	30.367	28.724	29.681	.928	.029	.283	100	26	74



DURFEE PLANT HOUSE.

SENATE...... ......No. 75.

EIGHTH ANNUAL REPORT

OF THE

TRUSTEES

OF THE

Massachusetts Agricultural College.

JANUARY, 1871.

BOSTON:
WRIGHT & POTTER, STATE PRINTERS,
79 MILK STREET (CORNER OF FEDERAL).
1871.

INDEX.

Commonwealth of Massachusetts.

AMHERST, Feb. 1st, 1871.

HON. H. H. COOLIDGE, *President of Massachusetts Senate.*

SIR:—I have the honor herewith to transmit to the Legislature the Eighth Annual Report of the Trustees of the Massachusetts Agricultural College.

Very respectfully,
Your obedient servant,

W. S. CLARK, *President.*

ANNUAL REPORT.

To the Honorable Senate and House of Representatives:

The Trustees of the Massachusetts Agricultural College respectfully present the following Report for the year 1870.

A gracious Providence has continued to smile upon our efforts and crown them with success. During the past year, entire harmony has prevailed among the trustees, overseers, and faculty, and all have worked together to advance the interests of the institution. His Excellency Governor Claflin has been pleased to visit the college twice, and to express his gratification with the condition of its affairs.

Faculty and Students.

The number of students has been larger than ever before, and greater than the dormitories could properly accommodate. The general conduct and spirit of the several classes have been excellent, and the progress in study, as good as could be reasonably expected where so many distracting demands are made upon the student for manual labor, military drill, and the various practical operations connected with surveying, chemistry, and natural history.

The course of instruction as at present arranged gives general satisfaction, and it is especially worthy of mention that the tendency among the young men is very decidedly towards the full period of four years. Many who enter with the intention of remaining only a term or two, decide to join one of the regular classes and become candidates for a degree. They soon learn that the road to a thorough knowledge of agriculture is neither short nor easy, and hunger for an understanding of those sciences which alone can explain its difficult problems.

The instruction is given by the president and six resident professors, who are assisted in particular departments by non-

resident lecturers, selected on account of their special familiarity with the topics of their respective courses.

One additional resident professor is needed and will be appointed as soon as the funds of the college will warrant it. This officer should be competent to teach zoölogy, physiology, comparative anatomy, and especially veterinary science. He should reside upon the farm and maintain there for purposes of instruction a hospital for diseased animals of all kinds. Only in this way can the students acquire a useful, practical knowledge of this most important subject, and learn how to treat safely and skillfully such cases as may come under their observation in after life. There are but few educated veterinarians in the Commonwealth, and most of these reside at Boston ; and as a consequence, the treatment of our horses and cattle when lame or sick is often irrational and barbarous in the extreme. Aside from the prevention of much needless suffering, the graduates of the college, if educated as they should be in this department, would save an immense amount of property which is now constantly going to waste through ignorance.

Professor James Law of Cornell University has given an excellent course of lectures on this subject the past summer, and accompanied his oral teachings by actual demonstration upon living animals so far as practicable. But the proper treatment of diseased animals demands much time, which can only be secured by having a hospital under the charge of a competent resident professor. With more knowledge respecting the causes, nature, and proper treatment of the diseases of domestic animals among our farmers, the difficulty and expense of controlling contagious distempers, like that now prevailing, would be greatly diminished.

For this department, also, are needed drawings, skeletons, and models, illustrating the animal structure both in the healthy and the diseased condition.

In the midst of our prosperity, the reaper Death has for the first time come among us and removed, as by a single stroke, both a beloved professor and a highly esteemed pupil.

Mr. Charles F. Sanderson of Petersham died September 13th, very suddenly, of inflammation of the brain. He was a special student, pursuing botany and chemistry preparatory to

the study of medicine. His character was irreproachable and his scholarship superior.

Professor S. F. Miller died, October 28th, of a cancerous affection of the bowels. During the two years of his service at the college, he won the highest respect from all with whom he came in contact. Thoroughly accomplished as a civil engineer, he was deeply interested in the applications of science to works of public utility. He was very industrious and found time, besides performing his duties as instructor with rare fidelity and success, to engage in many other affairs of importance. He surveyed the line of the Massachusetts Central Railroad from Belchertown to Northampton; assisted in locating and grading numerous walks and roads in Amherst; prepared a plan for the introduction of water from Pelham; wrote a prize essay on the highways of the State and the best method of constructing and repairing them; and originated the idea of establishing true meridian lines in different parts of the Commonwealth, and requiring all surveys to be made with reference to them. Having been appointed by the governor surveyor of meridian lines, he was actively engaged in the business of this office when prostrated by the last violent attack of the obscure disease from which he had suffered many months previously.

To lose a man of his noble character, large experience, and intellectual ability, is a great calamity to both the college and the Commonwealth. His colleagues and pupils will cherish his memory.

Professor M. H. Fisk has assumed the duties of the chair occupied by the lamented Professor Miller, and having had much experience as a teacher, and also as a practical surveyor and engineer, will, doubtless, give satisfaction as his successor.

The college has been exceedingly fortunate in securing, as special instructor of the senior class, Professor H. W. Parker, who has achieved a most enviable reputation as professor in Iowa College. He came with the very highest testimonials as to character, enterprise, and scholarly attainments, and has given entire satisfaction in the performance of his duties during the first term of the present collegiate year.

In addition to the distinguished lecturers who have previously honored us with their valuable services for a mere nominal price, we are so fortunate as to have secured the following for

the ensuing year:—George B. Emerson, LL.D., of Boston, author of "Trees and Shrubs of Massachusetts," will lecture on Arboriculture; Alonzo Bradley, Esq., of Lee, president of the Massachusetts Bee-Keepers' Association, will lecture on Bees and their management; M. F. Dickinson, Jr., Esq., of Boston, will lecture on Law as applied to rural affairs; and Professor William R. Ware, of Boston, on Architecture with special reference to agricultural requirements.

Agricultural Department.

This department has been managed by Professor Stockbridge with his usual skill and success. The students under his direction have done a great amount of labor, much of it of the least interesting and most disagreeable kind, such as ditching, stump-pulling, and digging up old orchards. The beauty and value of the farm have thereby been greatly increased, especially of that portion lying east of the highway and designed in part for planting as an arboretum and botanic garden. The theoretical instruction has been given by lectures, and has been thorough and interesting.

The immediate control of the farm work has devolved upon Mr. John C. Dillon, who entered upon his duties as farm superintendent on the first of April, and has done exceedingly well. He has manifested the utmost fidelity, strict honesty, a hearty interest in the general welfare of the college, as well as of his own special department, and good temper and judgment in his intercourse with the students.

From his report it appears that there were cultivated on the college farm the past season about eighteen acres of oats, nine acres of corn, three of potatoes, one of fodder corn, one of turnips, and one of garden vegetables. These all gave good returns, except the oats, which suffered somewhat from the drought, and from the fact that circumstances postponed the sowing at least ten days longer than was desirable. The hay crop amounted to 168 tons, and was of superior quality.

The stock upon the farm has been much improved by the purchase of a considerable number of excellent thoroughbred cows and heifers. The herd now contains fourteen Shorthorns, five Ayrshires, four Devons, and four Jerseys, a catalogue of which is appended to this Report. There are, also, on the farm twenty-

seven grade cattle; twenty-seven Southdown sheep; nineteen swine of the Suffolk and Chester White breeds; and six horses.

Outside of the regular farm operations, the teams have done a large amount of work in making and repairing roads, and in grading. The knoll in front of College Hall has been removed, and the drive-way across the ravine north has been widened and raised.

In regard to the wages paid to students for labor, the superintendent says:—

"Most of this money has been well earned. This means more than at first sight may appear; for to earn a given sum when embarrassed with study, and the necessity of constant change between the barn and the lecture-room, requires a far greater effort than is needed when there are no such conflicting claims."

He, also, speaks as follows respecting the importance of the labor fund which has been alluded to as most desirable in the last two annual reports:—

"I would respectfully suggest that, if either by an appropriation from the State or by private beneficence a fund could be provided for employing industrious students at a fair rate without too strict regard to the immediate value of their labor, the farm would be benefited, the interest of the students in its operations would be increased, habits of industry would be fostered, and a very deserving class of young men, who would unite thorough practical experience with accurate scientific knowledge, would be encouraged and assisted to become valuable members of the agricultural community."

While the general farm management has been, perhaps, as good as circumstances would allow, it is not surprising that the expenditures for the year have largely exceeded the receipts. The reasons for this are many and obvious. In the first place, the amount paid for labor to students is $1,750, and while it is not more than they ought to receive as a reward for their services, is still an outlay which, if the farm were not part of an educational institution, might be very largely reduced. Again, much of the work has been for purposes of permanent improvement, and therefore is not represented on both sides of the

account. Moreover, until the farm superintendent has had an opportunity to become acquainted with his surroundings, and with the duties of his office, and to make systematic arrangements for the operations of the year before the busy season, he can hardly be expected to succeed as well as when more favorably situated.

Agricultural Experiments.

The experiments of the past year have been directed to the cultivation of the sugar-beet, for the purpose of learning what varieties were best adapted to our soil and climate, and what per cent of sugar might be expected from them.

Professor Goessmann early in the year sent to Germany and procured seeds of the thirteen best sorts cultivated in Saxony and Prussia. These were sown upon the ground which happened to be in the best condition for them and a fair crop obtained, notwithstanding the unpropitious season. The juice of these different kinds of beet was expressed by means of a portable cider-mill, and subjected to careful examination to determine the per cent of sugar. The results were quite variable, but very satisfactory, the percentage varying from 7.20 to 15.61, the average being 11.5.

The accompanying report by Professor Goessmann upon the production of beet-sugar in Massachusetts will be found replete with valuable and altogether reliable information, and is believed to be a very important contribution to our agricultural literature. The learned professor is eminently qualified to discuss the subject, having been familiar with the business as carried on in his native country, and having had his attention for many years specially directed to it while engaged in refining sugars.

If the necessary funds be obtained in season, it is proposed to import a large quantity of seed from Germany, and plant on the college farm and in its vicinity several acres of beets the coming spring for the purpose of manufacturing a few tons of sugar, and thus learning by actual experiment what difficulties are to be overcome, and what results may be reasonably expected in this new but most important branch of industry.

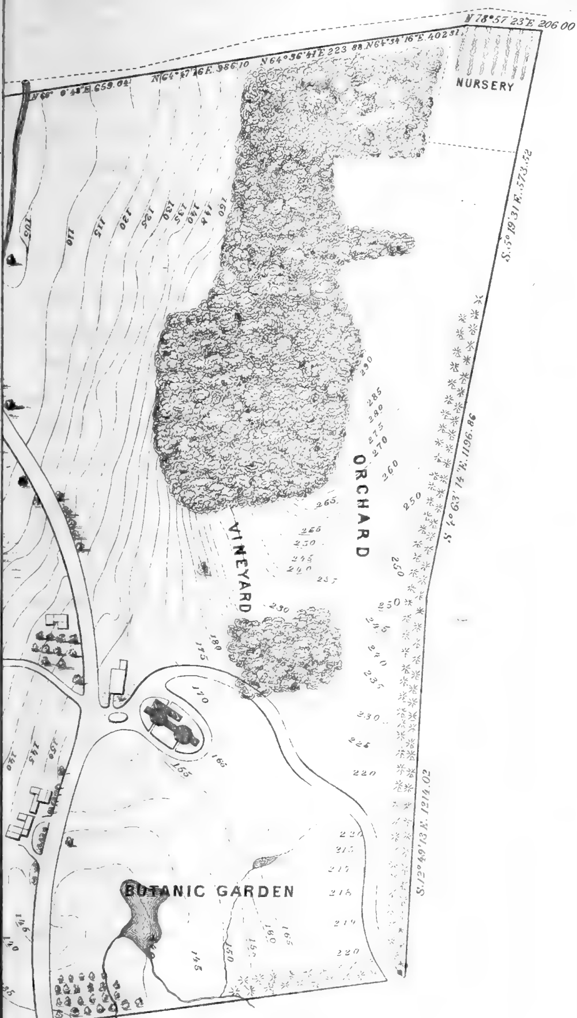
To provide the necessary apparatus for a small sugar factory will require an expenditure of not less than $5,000. A more satisfactory and more permanent establishment, sufficiently

extensive to work several tons of roots daily would cost about $10,000. Such a factory would not only be useful for this experiment, but afterward serve as necessary apparatus for the education of young men in the art of making and refining sugar.

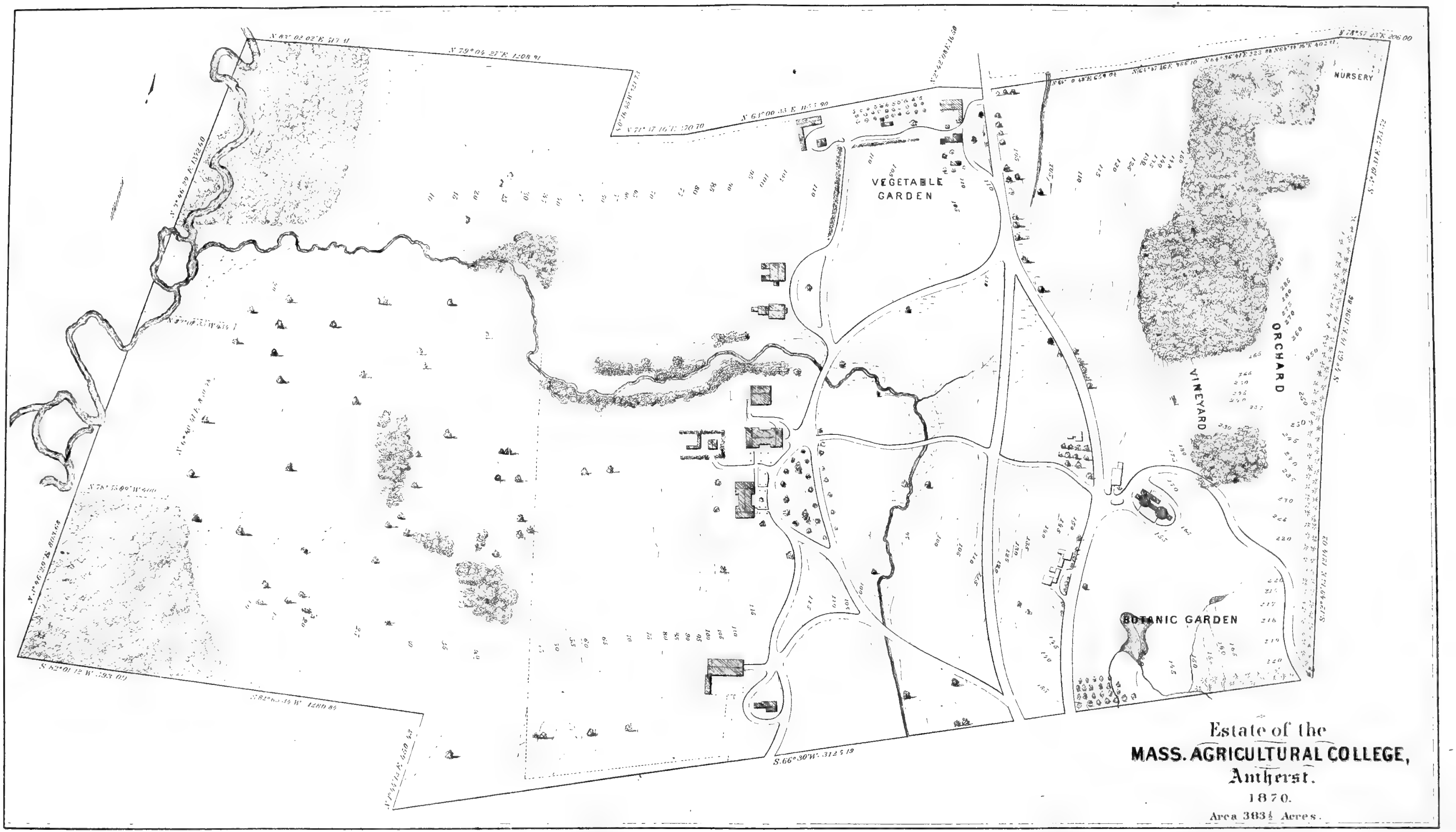
The soil and climate of Massachusetts are peculiarly adapted to the production of sugar beets of the best quality, and when we consider the marvelous development of the sugar manufacture in Europe, and its extraordinary influence in increasing the productive power of the soil, in improving the methods of farming, in multiplying the number of cattle, and thus in furnishing an abundant supply of sugar, milk, and meat, we cannot fail to desire its introduction at the earliest practicable moment. In Germany, France, and Russia, the expenses of the first experiments have been borne by the government, and now the tax on this crop is a very important source of revenue. In France, more than one sixth of the cultivated land is devoted to the beet, and the product of sugar the past year was 276,000 tons, yielding a revenue of about $13,000,000, besides more than 7,000,000 gallons of alcohol, distilled directly from the beet juice and paying a tax of nearly $3,000,000. But the indirect advantages to the government far surpass the direct. More sugar is now produced both in France and Germany than is consumed, although the consumption is rapidly increasing, and, therefore, no money is sent abroad for this indispensable article of food. At the same time the capacity of the country to supply bread and meat is also enlarged to a remarkable degree. In a single limited district of France, the introduction of beet culture has increased the number of oxen from 700 to 11,500, and the annual yield of wheat from 976,000 bushels to 1,168,000.

The number of sugar factories in Europe is now more than 1,400, and constantly augmenting.

The Agricultural College ought to be made an experimental station, similar to those now so common in Germany, and which are universally admitted to have paid back to the government many times their cost by the valuable information they have afforded as the result of their investigations. There can be little doubt that the establishment of a fund, the income of which should be employed to defray the necessary expenses of scientific experiment and research, would be a most profitable investment of money in the interest of agriculture. As such



Estate of the
MASS. AGRICULTURAL COLLEGE,
Amherst.
1870.
Area 363½ Acres.


NURSERY
VEGETABLE GARDEN
ORCHARD
VINEYARD
BOTANIC GARDEN
S.66°30'W. 3124.19
Estate of the
MASS. AGRICULTURAL COLLEGE,
Amherst.
1870.
Area 383¼ Acres.

undertakings require usually some time for preparation, and must often be continued through a series of years in order to attain conclusive results, it is evident that some permanent provision should be made for this work. If the sum of $1,000 per annum were provided for this object, it would stimulate a spirit of inquiry among the officers and students of the institution and unquestionably result in much good. May we not hope that some wealthy and public-spirited friend of progressive agriculture will soon feel inclined to establish such a fund?

Map of Farm.

The accompanying plan of the college estate was drawn by Mr. S. F. Maynard, of the junior class, from the map made some years since by J. Herbert Shedd, C. E., of Boston, to which have been added the roads, walks, and buildings constructed since 1866. To a person familiar with such maps it gives an excellent idea of the topographical features of the farm, which is beautifully located and admirably adapted for the purposes of the Agricultural College.

Horticultural Department.

The operations in this department have been confined mostly to the care of the Durfee Plant-House, the vineyard, the orchard, and the nursery, and the preparation of the plan and ground for planting the Arboretum and Botanic Garden.

The Victoria regia has blossomed freely and is still thriving. This magnificent species produces the largest flower and leaf of any plant in cultivation. The leaf has been grown to the size of nine feet in diameter, and capable of floating the weight of an ordinary man. The flower resembles a superb and fragrant pond-lily, being white with a beautiful rose-colored center, and attains a diameter of one foot.

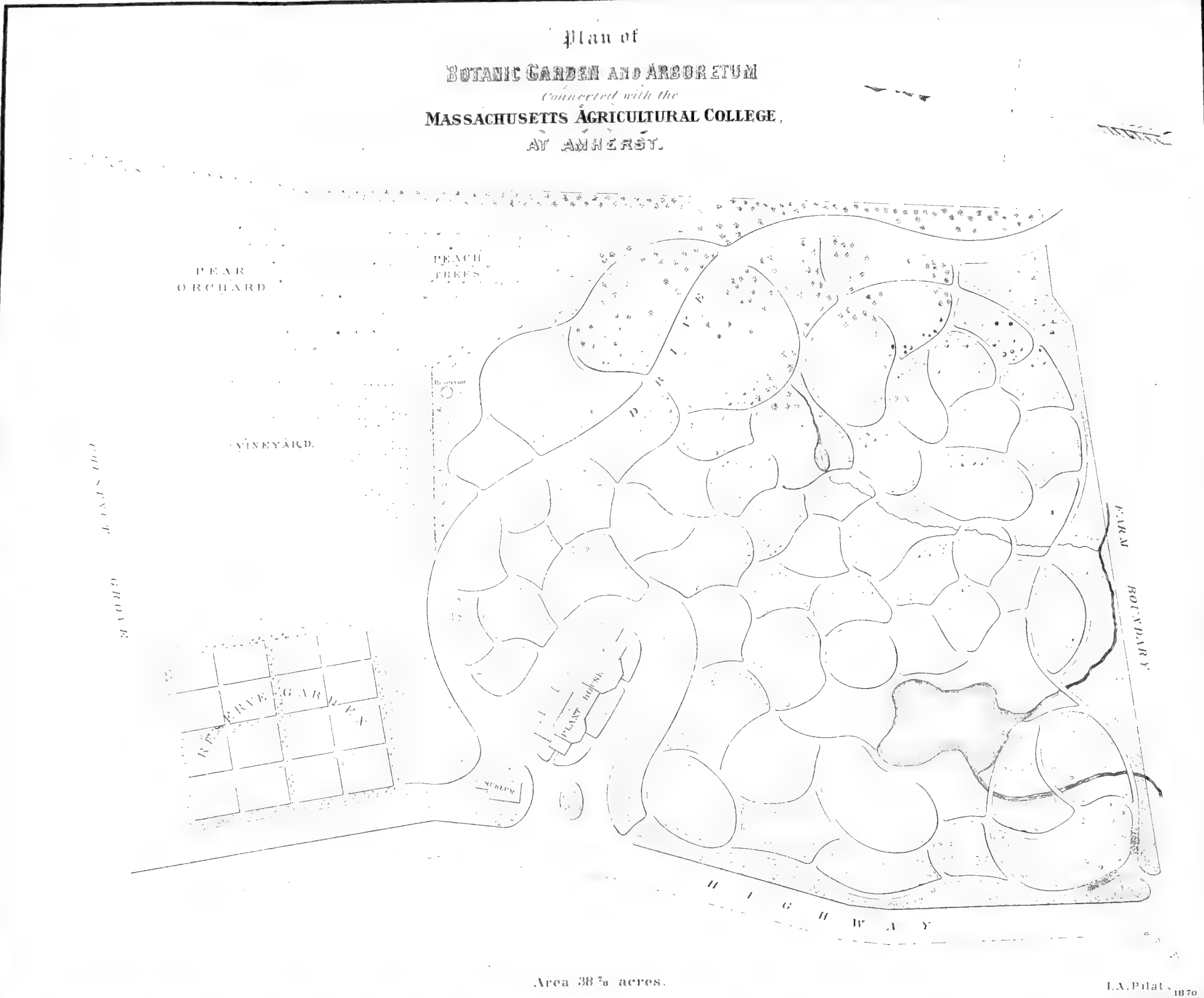
The noble specimen of Stenocarpus Cunninghami, presented by Colonel Wilder, has bloomed abundantly and attracted much attention from the richness of its evergreen foliage and the singular beauty of its flowers.

Several new species of particular interest have been obtained and the general condition of the plants under glass is good. A valuable collection of plants has been received from Professor Asa Gray, of the Cambridge Botanic Garden, and some choice

seeds of conifers from the Pacific Coast have been presented by Dr. George B. Emerson, of Boston. Many species of tree seeds have been sown in the open ground and a large number of young specimens are coming forward.

The most urgent want of this department is glass houses for the cultivation of choice plants and garden vegetables. If, in addition to the extensive structures erected by Dr. Durfee, there were built three hundred feet in length of houses like the present propagating pits at a cost of $3,000, the expenses of this entire establishment might be defrayed by the sale of plants, flowers, and vegetables. This would save at least $1,000 per annum to the treasury, and render the instruction in horticulture much more practical and useful than it can be at present.

After much study, a design for the Botanic Garden and Arboretum has been perfected with the assistance of the late accomplished chief gardener of the New York Central Park, Mr. I. A. Pilat, who has, also, prepared a catalogue of desirable species for planting. The accompanying plan includes an area of about forty acres which is admirably adapted to the purpose for which it is designed, as will appear from an examination of the plan of the farm, where its topography is exhibited. It is proposed to proceed with the laying out of these grounds as soon as a fund of $50,000 has been secured for their perpetual maintenance. It is confidently expected that citizens of taste and wealth will be willing to contribute toward so desirable an object. The income of such a fund would not only serve to keep these ornamental grounds in order, but, also, furnish means for the support of indigent students who would gladly do the work for moderate compensation. Such a garden would not only be exceedingly delightful as a place of resort for students of both the colleges of Amherst, and for the public generally, but would be extremely useful for scientific purposes, and for the acclimation and trial of new and valuable trees, shrubs, and herbaceous plants. As the gifts of private individuals to this department have already amounted to more than $25,000, and as the Durfee Plant-House and the Knowlton Herbarium have been highly appreciated by all who have visited them, it cannot be doubted that the work so well begun will be carried forward to completion.


Plan of
Botanic Garden and Arboretum
Connected with the
Massachusetts Agricultural College,
At Amherst.
PEAR ORCHARD
PEACH TREES
VINEYARD.
Reservoir
DRIVE
GROVE
RESERVE GARDEN
PLANT HOUSE
MUSEUM
FARM BOUNDARY
HIGHWAY
Area 38 7/8 acres.
I. A. Pilat, 1870

CONCLUSION.

The success of the college as an educational institution is now universally conceded, and with wise management there will be no lack of patronage. The course of instruction is designed to develop the faculties of the student harmoniously and prepare him for a practical career of usefulness. He is made familiar with the most important truths of the natural sciences, as well as of agriculture and horticulture, and is taught to believe and feel that farming is an occupation worthy his best efforts and more certain than any other to furnish a competent support and a comfortable home to a man of intelligence, industry, and moderate capital. There are at least five thousand young men on the farms of the Commonwealth who ought, if it were practicable, to enjoy immediately the advantages of the college. The time and money expended in securing such an education as it affords would yield to them in after life a larger return in cash than if invested in any other manner; besides which, the increased influence and the pleasure resulting from knowledge and culture would be above all price. It is deeply to be regretted that so many independent farmers fail to appreciate the benefits of education, and, therefore, are more ready to question the utility of the Agricultural College or to criticize its management than to dispense with the valuable services of their sons at home and pay their expenses during the four years of study.

Still there are more students constantly in attendance than the dormitories were intended to accommodate, and the principal want of the institution is now, as heretofore, new buildings. In accepting the grant from Congress and the subscription from the town of Amherst, the State entered into a contract to provide the necessary buildings and keep them in repair. Nothing which has been erected remains unoccupied, and it seems reasonable that additional edifices should be built as soon as the condition of the finances will warrant the expenditure. Until this is done, annual appropriations will be demanded to carry out the plan which was formed in the beginning, and which has proved so excellent as to have won for the Massachusetts Agricultural College the reputation of being one of the most successful institutions of the kind ever established.

The ordinary expenses are now as large as they would be with twice the number of students. The salaries of the faculty

for the year 1871 amount to $16,750, and are provided for by the income of the fund and the receipts for tuition. The salaries and wages of other employés, as assistant treasurer, farm superintendent, gardener, teamsters, and students, will reach an aggregate of $8,400, and are in part met by the receipts from the sale of farm produce, leaving a balance of $5,000 to be provided by legislative appropriation. Under good management, since the condition of the farm is rapidly improving, the receipts from sales will steadily increase, and, at no distant day, should be sufficient to pay all the above expenses.

The other necessary expenditures are for expenses of trustees, interest, fuel, general repairs, printing and advertising, freight and express charges, office expenses, &c., and amount to an estimated sum of $6,000.

Among the most important extraordinary expenses, for which appropriations should be made, are the following, viz.: for the purchase of apparatus for the manufacture of beet sugar, $5,000; for the construction of glass houses for the cultivation of plants and vegetables for sale, $3,000; for the erection of a sheep barn, piggery and sheds in connection with the south barn, to replace what was destroyed by a violent wind in February last, $3,000; for apparatus in the department of physics and astronomy, for the use of which the college now pays $500 per annum, $5,000; and for the extension of the aqueduct pipe to the chemical laboratory, supplying at the same time the two dormitory buildings, $1,000.

In conclusion, believing that professional education is the special want of our agriculture, and that the public policy adopted of offering it in an economical and attractive form to the farmers of the Commonwealth is eminently wise and worthy of continuance, we commend the college under our charge to your favorable consideration.

Respectfully submitted,
By order of the Trustees,

W. S. CLARK, *President*.

AMHERST, January, 1871.

CATALOGUE

OF

TRUSTEES OVERSEERS, FACULTY, AND STUDENTS.

1870.

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MARTIN H. FISK, M.A.,
Instructor in Mathematics and Civil Engineering.

JOHN K. RICHARDSON, B.A.,
Instructor in Mathematics.

ELIHU ROOT, B.A.,
Instructor in Rhetoric and Elocution.

Prof. JAMES LAW, F.R.V.C.,
Lecturer on Diseases of Domestic Animals.

Hon. CHARLES L. FLINT,
Lecturer on Dairy Farming.

CALVIN CUTTER, M.D.,
Lecturer on Hygiene.

* Deceased.

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Lecturer on Civil Polity.

JABEZ FISHER, M.D.,
Lecturer on Market Gardening.

Prof. EDWARD HITCHCOCK, M.D.,
Lecturer on Comparative Anatomy.

Hon. MARSHALL P. WILDER,
Lecturer on Pomology and Floriculture.

A. S. PACKARD, Jr., M.D. (State Entomologist),
Lecturer on Useful and Injurious Insects.

Prof. EBENEZER S. SNELL, LL.D.,
Lecturer on Physics.

GEORGE B. LORING, M.D.,
Lecturer on Stock Farming.

Prof. L. CLARK SEELYE,
Lecturer on English Literature.

GEORGE B. EMERSON, LL.D.,
Lecturer on Arboriculture.

ALONZO BRADLEY, Esq.,
Lecturer on the Honey Bee.

MARQUIS F. DICKINSON, Jr., Esq.,
Lecturer on Rural Law.

Prof. WM. R. WARE, B.S.,
Lecturer on Architecture and its Application to Rural Affairs.

GEORGE F. MILLER,
Teacher of Vocal Music.

JOHN GRIFFIN, Gardener.

JOHN C. DILLON, Farm Superintendent.

Senior Class.

Allen, Gideon Hammond,	Marion.
Bassett, Andrew Lewis,	Amherst.
Birnie, William Perkins,	Springfield.
Bowker, William Henry,	Phillipston.
Brown, Clarence Eaton,	Northampton.
Caswell, Lilley Brewer,	Fitchburg.
Cowles, Homer Lucian,	Hadley.
Ellsworth, Emory Alexander,	Barre.
Fisher, Jabez Franklin,	Fitchburg.
Fuller, George Elwyn,	Greenfield.
Hawley, Frank Warren,	Hadley.
Herrick, Frederick St. Clair,	Lawrence.
Leonard, George,	New Bedford.
Lyman, Robert Worthington,	Easthampton.
Morse, James Henry,	Salem.
Nichols, Lewis Abel,	Danvers.
Norcross, Arthur Dickinson,	Monson.
Page, Joel Bardwell,	Conway.
Richmond, Samuel Howard,	Taunton.
Russell, William Delano,	Sunderland.
Smead, Edwin,	Greenfield.
Southwick, Alonzo Lewis,	Blackstone.
Sparrow, Lewis Addison,	Medway.
Strickland, George Porter,	Amesbury.
Thompson, Edgar Eliab,	Hopkinton.
Tucker, George Homer,	Spring Creek, Pa.
Ware, Willard Carroll,	Salem.
Wheeler, William,	Concord.
Whitney, Frank Le Prelet,	Boston.
Woolson, George Clark,	Hopkinton.
Total,	30.

Junior Class.

Ames, William Campbell,	Conway.
Bell, Burleigh Cook,	Winchester.
Blood, Alonzo Hutchinson,	Winchester.
Brett, William Franklin,	North Bridgewater.
Clark, John Wesley,	Hadley.
Cole, Daniel Pomeroy,	Springfield.
Cowles, Frank Colton,	Amherst.
Crocker, Loring, Jr,	Barnstable.
Cutter, John Clarence,	Warren.
Dyer, Edward Norris,	Shrewsbury.
Easterbrook, Isaac Henry,	Boston.
Fisk, Edward Ransom,	Amherst.
Flagg, Charles Otis,	Westminster.
Grover, Richard Baxter,	Amherst.
Harrington, Frank Warner,	Amherst.
Holmes, Lemuel Le Baron,	Mattapoisett.
Howe, Edward Gardner,	Chicago, Ill.
Kimball, Francis Elliot,	Dudley.
Lester, Frank Harris,	Plainfield, Conn.
Livermore, Russell Woolcott,	Bozrahville, Conn.
Lockey, John Morse,	Leominster.
Mackie, George,	New Bedford.
Maynard, Samuel Taylor,	Northborough.
Morey, Hubert Ellis,	Malden.
Peabody, William Russell,	Boston.
Penhallow, Charles, Lowell,	Portsmouth, N. H.
Salisbury, Frank Battelle,	Sherborn.
Shaw, Dwight Elliot,	Chicopee.
Snow, George Henry,	Leominster.
Somers, Frederick Maxwell,	Greenfield.
Thomas, George Hutchins,	Lebanon, Conn.
Thompson, Samuel Clarence,	Southborough.
Wells, Henry,	Stockbridge.
Whitney, William Channing,	Harvard.
Total,	34.

Sophomore Class.

Baker, Frederick William,	Winchester.
Barrows, Fletcher Kneeland,	Brattleboro', Vt.
Carter, Herbert Mason,	Winchester.
Clark, William Jared,	Cincinnati, O.
Cleland, William Francis,	Natick.
Copp, Belton Allyn,	Groton, Conn.
Flower, Archibald Dick,	Ashfield.
Frisbie, George Benedict,	New York.
Furness, George Abbot,	Tarrytown, N. Y.
Garrett, William Edward,	West Newton.
Healey, George Clifford,	Hampton Falls, N. H.
Jefts, Melvin Willard,	Ashland.
Johns, Frederick Durfee,	St. Charles, Mo.
Lathrop, Joseph Dwight,	Northampton.
Leland, Walter Sherman,	Sherborn.
Lyman, Asahel Hubert,	Huntington.
Mills, George Westgate,	Medford.
Mines, William Wales,	Brooklyn, N. Y.
Minor, John Bacon,	New Britain, Conn.
Penhallow, David Pearce,	Portsmouth, N. H.
Renshaw, James Budden,	Richmond.
Smith, Jasper B.,	Newburyport.
Simpson, Henry Bell,	Hudson, N Y.
Warner, Seth Smith,	Northampton.
Warriner, Alfred Allen,	Warren.
Webb, James Henry,	New Haven, Conn.
Wellington, Charles,	Amherst.
Total,	27.

Freshman Class.

Alexander, Edward Percival,	Greenville, Ill.
Barstow, William Hale,	Haverhill, N. H.
Benedict, John Mitchell,	Bethel, Conn
Briggs, Louis Willard,	Plaquemine, La.
Chandler, Edward Phelps,	Westborough.
Clark, William Avery,	Springfield.
Clark, Wallis Olwyn,	Chelsea.
Curtis, Wolfred Fletcher,	Westminster.
Dickinson, Asa Williams,	Amherst.
Doubleday, Henry Mather,	Brooklyn, N. Y.
Doubleday, William Horace,	Brooklyn, N. Y.
Duncan, George Adams,	Keene, N. H.
Fisk, Charles Abbott,	Springfield.
Gillett, Edward,	Southwick.
Johns, Arthur Clifford,	St Charles, Mo.
Lyman, Henry,	Middlefield, Conn.
Lyman, William,	Middlefield, Conn.
Millard, David Knox,	Northampton.
Mitchell, William H.,	Chicago, Ill.
Montague, Arthur Huntington,	Granby.
Moody, George Frederick,	Springfield.
Ould, Remus,	Baltimore, Md.
Pearce, Walter Sloan,	Frazer, Pa.
Rowland, Clarence Warner,	West Newton.
Shaw, Charles Jacob,	Boston.
Smith, Frank Stockbridge,	Springfield.
Smith, James Metcalf,	Westfield.
Strain, William,	Southwick.
Towne, Frank Augustus,	Keene, N. H.
Zeller, Bruce Scott,	Hagerstown, Md.
Zeller, Harrie McKeen,	Hagerstown, Md.
Zeller, William Melville,	Hagerstown, Md.
Total,	32.

Select Class.

Adams, Frank Edgar,	Hadley.
Annable, Robert Whipple,	Portsmouth, N. H.
Ariail, Smith,	Stockbridge.
Avery, Frank Rhodes,	Westfield.
Barber, Strong Hayden,	Windsor, Conn.
Bayley, Jonathan,	Northampton.
Blankinship, Edwin Augustus,	Marion.
Bliss, Albert Nathaniel,	Brattleboro', Vt.
Capen, Thomas Allyn,	Taunton.
Colby, Daniel Thompson,	Newburyport.
Cooke, Charles Montague,	Honolulu, Hawai'n I.
Damon, Edward,	Honolulu, Hawai'n I.
Eldred, Frederick Cornelius,	Sandwich.
Hardy, Edward Eldridge,	Boston.
Post, Henry Watross,	Brattleboro', Vt.
Sanderson, Charles Franklin,*	Petersham.
Sanderson, Robert Wilson,	Amherst.
Smith, William Owen,	Koloa, Hawaiian I.
Swazey, Walter West,	Springfield.
Watkis, James Edwin,	Brooklyn, N. Y.
Wills, John Wheelright,	Boston.
Wood, Frank Warren,	Grafton.
Total,	22.

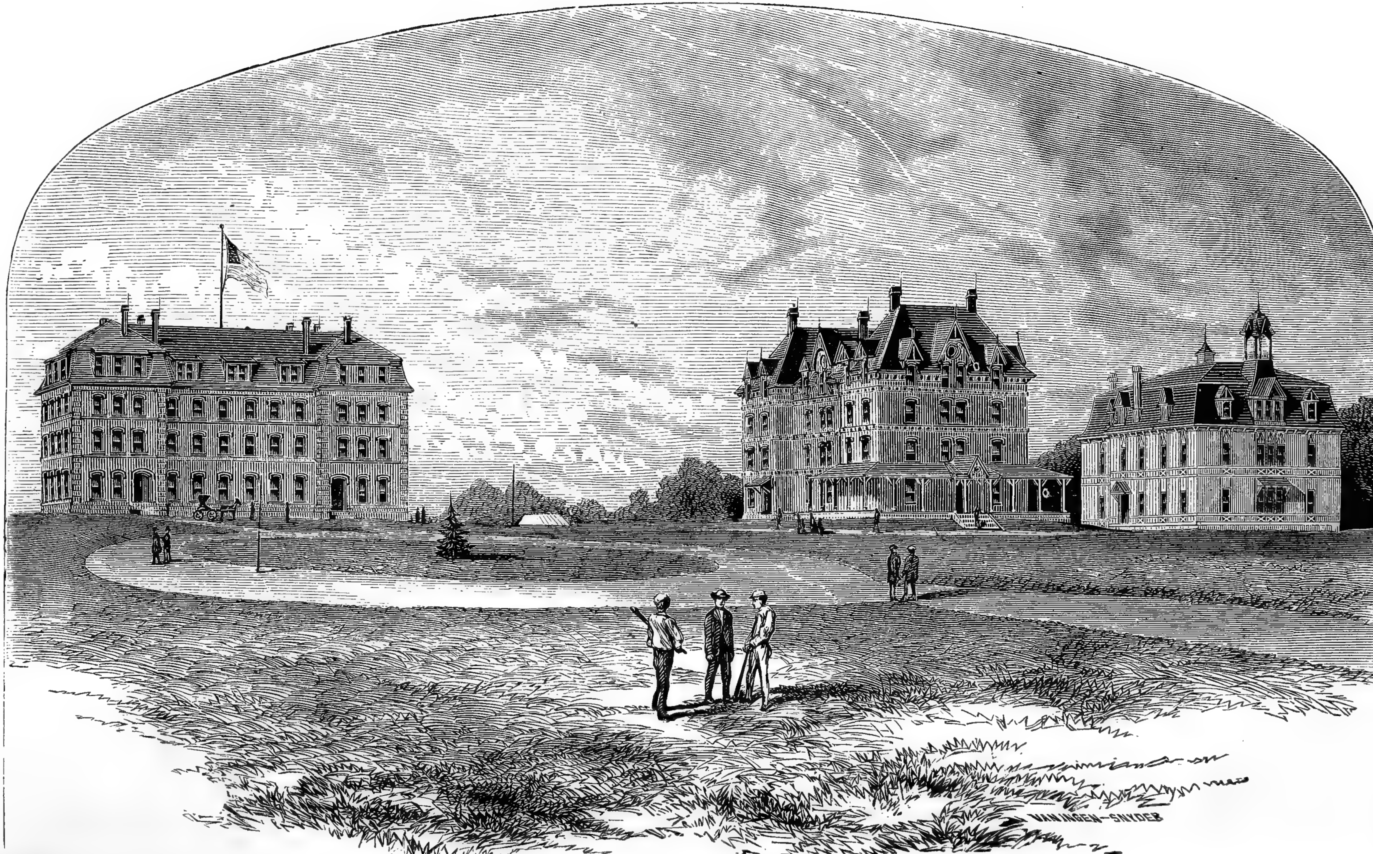
Resident Graduates.

Garrigues, Samuel S., Ph. D.,	East Saginaw, Mich.
Heyl, Jacob E., B.S.,	Philadelphia, Pa.

Summary.

Seniors,	30
Juniors,	34
Sophomores,	27
Freshmen,	32
Select,	22
Resident Graduates,	2
Total,	147

* Deceased.



MASSACHUSETTS AGRICULTURAL COLLEGE.

COURSE OF STUDY AND INSTRUCTION.

Freshman Year.

First Term.—Recitations in Human Anatomy and Physiology; Chemical Physics; and Commercial Arithmetic and Book-keeping. Lectures on Agriculture: *first*, its importance as an Art, and its relations to other pursuits; *secondly*, as a Profession, and the education it requires; and *thirdly*, of Soils, their origin, varieties, and composition. Lectures on the properties of Matter and the nature and effects of the forces, Heat, Light, and Electricity. Lectures on the Laws of Health. Instruction in Elocution; and in Penmanship, and Orthography, for such as are deficient in these branches. Military Drill; Infantry Tactics; School of the Soldier.

Second Term.—Recitations in Chemistry; and Algebra; Lectures on Agriculture; Improvement of Soils by chemical and mechanical means; Drainage; Irrigation; Tillage; Implements for, and methods of stirring and pulverizing the soil and subsoil. Lectures on the Chemistry of the Non-metallic Elements; the principles of Chemical Philosophy; the most important Metals and their uses in the Arts. Instruction in Elocution; Vocal Music; and English Composition. Military Drill; Infantry Tactics; School of the Company, and Manual of Arms.

Third Term.—Recitations in Algebra and Geometry; and French. Lectures on Agriculture; Sterility of Soils, its causes and remedies; Rotation of Crops. Lectures on Organic Chemistry; Instruction in the Laboratory in Analytical Chemistry. Instruction in Elocution, and Reading. Military Drill: Infantry Tactics; Schools of the Company and Battalion.

Sophomore Year.

First Term.—Recitations in French, with written exercises; Zoölogy; Geometry and Conic Sections. Lectures on Agriculture; Mineral Fertilizers; Organic Fertilizers; Animal Manure, its origin, varieties, value, and treatment; Waste of Fertilizers; Absorbents of liquid Manures: Composts; Application of Fertilizers. Lectures on Agricultural Chemistry; Instructions in the Laboratory in Practical Chemistry. Exercises in Declamation; and French Translation. Military Drill: Infantry Tactics; Manual of the Bayonet, and Instruction in duty as Skirmishers.

Second Term.—Recitations in French; Logarithms, Plane and Spherical Trigonometry, and Measurement of Lines, Surfaces, and Volumes. Lectures on Agriculture; Economy in the treatment and use of Soils, Manures, Crops, Teams, Laborers, Live Stock, Implements, Fences, and Buildings. Lectures

on Quantitative Analysis, and Practice in the Chemical Laboratory. Exercises in Declamation; and Vocal Music. Military Drill: Infantry Tactics; Bayonet Exercise.

Third Term.—Recitations in History; and Surveying, with Practical Land Surveying, Plotting, and Geometrical Drawing. Lectures on Agriculture; Farm Management; Selection of Lands. Division into mowing, arable, pasture, and woodland; Roads; Fences; Buildings; System to be adopted; Plans for each year; Cultivation and use of the various crops; Sources of profit in General Farming; Special Farming. Lectures on the Diseases of Domestic Animals; General Pathology; Fevers and Inflammation and their consequences; Glanders and Farcy; Diseases of Respiratory and Circulatory Organs; Diseases of Digestive Organs; Urinary and Generative Organs; Castration; Parturition and rules for assisting parturient animals; Diseases of Udder and Teats; Affections of the Nervous System; of the Eye; of the Skin; the Foot; Method of Shoeing; Wounds; Ulcers; Sprains; Diseases of the Bones and Joints; Dislocations and Fractures. Exercises in Reading; and Practice in Writing Sentences on the Blackboard. Military Drill: Infantry Tactics; Skirmish and Battalion Drill; Guard Duty; and Forms of Parade and Review.

Junior Year.

First Term.—Recitations in German; Mechanics of Solids and Liquids; and Physical Geography. Lectures on Agriculture; Market Gardening, including Small Fruits. Lectures on Useful and Injurious Insects. Instruction in Practical Leveling, and Topographical Drawing. Exercises in Reading Shakespeare. Military Drill: Artillery Tactics; School of the Piece.

Second Term.—Recitations in Mechanics of Air and Steam; Sound; Light; Heat; Electricity; German; and Structural Botany. Lectures on the Construction and Management of Plant-houses, and the Cultivation of Plants nnder glass. Lectures on Mechanics, and Statical Electricity. Instruction in Free-hand Drawing; Perspective; and Shades and Shadows. Exercises in Agricultural Discussion; and Vocal Music. Military Drill: Artillery and Cavalry Tactics; Manual of the Sabre; School of the Trooper dismounted; Instruction in Heavy Artillery Tactics and Gunnery.

Third Term.—Recitations in Astronomy; Systematic Botany; and German. Lectures on Milch Cows, and Dairy Farming. Lectures on Stock Farming, and the Breeding of Domestic Animals. Lectures on Physics; and Comparative Anatomy. Exercises in Debate. Military Drill: Artillery Tactics; School of the Section; Infantry Tactics; Battalion Drill.

Senior Year.

First Term.—Recitations in Mental Science; Rhetoric; and Civil Engineering for the Farm. Lectures on English Literature. Lectures on the Cultivation of Fruits and Flowers, and the art of producing new varieties. Instruction in Mechanical and Architectural Drawing; and in preparing Working Plans and Specifications. Exercises in Original Declamation. Military Drill: Cavalry, Artillery, and Infantry Tactics; Duty as Drill Mas-

ters and Officers in Infantry and Artillery Drill; Theoretical Instruction in Cavalry Tactics, and the organization and uses of Cavalry.

Second Term.—Recitations in Moral Science; Political Science and Economy; and English Literature. Lectures on Rural Law, including the Rights and Obligations of Landholders. Lectures on Arboriculture; the planting and care of Trees for the production of Fuel, Timber, Fruit, or for other purposes. Lectures on Military History; Military Law; and Courts-martial. Exercises in Original Declamation. Military Drill: Cavalry Tactics; Sabre Exercise.

Third Term.—Recitations in Landscape Gardening; Geology; and General Reviews. Lectures on Agricultural Botany. Lectures on Architecture, with special reference to Rural Affairs. Lectures on Mineralogy, and Geology; Meteorology; and Civil Polity. Exercises in Original Declamation. Military Drill: Target Practice; Sword Play; and General Drill.

Practice in the various operations of the Farm and Garden through the course.

Select Course.

Those who do not intend to pursue the full course, may select from the studies of the first, second, or third terms of any year in the curriculum, such instruction as they choose, provided they are qualified for it.

CALENDAR FOR 1871.

The second term of the collegiate year begins January 19, and continues till April 19.

The third term begins April 27, and continues till July 19.

The first term begins August 31, and continues till the Wednesday before Thanksgiving.

There is an Examination of candidates for admission to the College, at the Botanic Museum, at 9, A. M., Tuesday, July 18, and also on Thursday, August 31.

The annual Public Examinations, and the Prize Declamations take place Monday, July 17.

The Exercises of Class Day, and the Address before the Literary Societies, on Tuesday, July 18.

The Exercises of Graduation Day, with the conferring of Degrees by His Excellency Governor Claflin, and an Historical Address, by Hon. Marshall P. Wilder, on Wednesday, July 19.

ADMISSION.

Candidates for admission to the Freshman class, are examined in writing, upon the following subjects: English Grammar, Geography, Arithmetic, and the History of the United States.

Candidates for higher standing, are examined as above, and also in the studies gone over by the class to which they may desire admission.

No one can be admitted to the College until he is fifteen years of age, and every student is required to furnish a certificate of good character from his late pastor or teacher, and to give security for the prompt payment of term bills. Tuition and room-rent must be paid in advance at the beginning of each term; and bills for board, fuel, and washing, at the end of every term.

The regular examinations for admission are held at the Botanic Museum at 9 o'clock, A. M., on Tuesday, July 18, and on Thursday, August 31; but candidates may be examined and admitted at any other time in the year.

Further information may be obtained from President W. S. Clark, Amherst, Mass.

EXPENSES.

Tuition,	$18 00 per term.
Room rent,	5 00 "
Incidental expenses,	1 00 "
Board,	3 50 per week.
Washing,	50 per dozen.
Expenses of Chemical Laboratory to students of practical Chemistry,	5 00 per term.
Public and private damages, including value of chemical apparatus injured or destroyed,	at cost.
Annual expenses, including books,	$250.00 to $300.00

REMARKS.

The full course of study occupies four years, and those who complete it receive the degree of Bachelor of Science.

The instruction in the languages is intended to qualify the graduates to write and speak English with correctness and effect, and to translate French and German with facility. The scientific course is extensive and thorough, and as practical as possible. Every student has the opportunity of becoming a

good chemist, a skillful surveyor, and a civil engineer. At the same time, every science is taught with constant reference to its applications to agriculture and the wants of the farmer.

The instruction in agriculture and horticulture, includes every branch of farming and gardening which is practiced in Massachusetts, and is both theoretical and practical. Every topic is discussed thoroughly in the lecture-room, and again in the plant-house or the field, where every student is obliged to labor. The amount of required work, however, is limited to six hours per week, in order that it may not interfere with study. Students are allowed to do as much as they please, provided they maintain the necessary rank as scholars. All labor is paid at the rate of from ten to twenty cents per hour, according to its value.

There is no provision for indigent students, beyond the opportunity to do such work as may offer about the college and farm buildings, or in the field, and it is hardly possible to earn more than from fifty to one hundred dollars per annum, besides performing other duties. So far as is consistent with circumstances, students will be permitted to select such varieties of labor as they may for special reasons desire to engage in.

Those who pursue a select course attend recitations and lectures with the regular classes; but persons, properly qualified and desiring special instruction in chemistry, civil engineering, agriculture, or horticulture, may make private arrangements with the officers having charge of these departments.

An expenditure of from ten to fifty dollars is necessary to provide furniture, which may be purchased at reasonable rates, either new or second-hand, and re-sold upon leaving, if desirable.

On Sunday, students are expected to attend the chapel service and Bible-class, which are conducted by the professor of moral science. While the Bible is made the basis of all religious instruction, everything of a denominational character is as far as practicable avoided.

Students may, upon the written request of their parents or guardians, be excused from these exercises to attend services in one of the churches of the village.

BOOKS, APPARATUS, AND SPECIMENS IN NATURAL HISTORY.

The Library of the College contains about one thousand volumes. Among them are several valuable sets of cyclopædias, magazines and newspapers, reports of Agricultural Societies, and State Boards of Agriculture, and many standard works on Agriculture and Horticulture. There are also many excellent works of reference in Chemistry, Botany, Surveying and Drawing. The larger part of the books have been presented to the Institution by private individuals.

The faculty and students of the College also have access to the Library of Amherst College, which contains nearly thirty thousand volumes.

The State Cabinet of Specimens illustrating the Geology and Natural History of Massachusetts has been removed from Boston to the College, and is of much value for purposes of instruction.

The Knowlton Herbarium contains more than fifteen thousand species of named botanical specimens, besides a large number of duplicates. The Botanic Museum is supplied with many interesting and useful specimens of woods, seeds, and fruit models.

About one thousand species and varieties of plants are cultivated in the Durfee Plant-House, which yields a perennial supply of enjoyment and information to the students of both colleges.

The very extensive and, in many respects, unsurpassed collections in Geology, Mineralogy, Natural History, and Ethnology, belonging to Amherst College, are accessible to members of the Agricultural College.

Lectures upon Physics must also be given to agricultural students at Amherst College, until apparatus is provided for this indispensable department.

The Chemical, Engineering, and Military departments of the Agricultural College are well furnished.

GIFTS.

The following persons have shown their kind interest in the College during the year by donations, namely :—

Mrs. A. B. Howe, of Springfield, gift of $30 and a loan of $200 to indigent students.

Mr. Joseph Nee Sima, of Japan, collection of 100 varieties of Japanese seeds.

Messrs. R. P. Eaton & Co., of Boston, 3 volumes "New England Farmer."

Wm. Knowlton, Esq., of Upton, loan of $100 to indigent student.

Hon. E. H. Hyde, of Stafford, Conn., 3 volumes Reports of Connecticut Board of Agriculture, 1866-67-68.

Rev. M. D. Sanders, missionary, a valuable work in the Tamil language, written on palmleaf, and a collection of seeds from Ceylon.

Hon. F. F. Holbrook, of Boston, agricultural implements.

Col. E. Stone, of Dedham, $20 for books, a valuable photograph, a barrel of seed potatoes, and a collection of hardy roses.

Hon. Peter Harvey, of Boston, a photograph of an immense plow, made and used by Daniel Webster.

Hon. Richard Goodman, of Lenox, $50 for indigent student, and barrel of seed potatoes.

Mr. Levi Janney, Jr., of Fairhaven, two Sicilian Nut Trees.

From the publishers, "Boston Journal of Chemistry," "New England Farmer," "New England Homestead," "Massachusetts Ploughman," "Bowdoin Scientific Review," "California Farmer," "Prairie Farmer," Publications of the Essex Institute, "Boston Cultivator," "Albany Cultivator and Country Gentleman," "Hearth and Home," "Rural World," "American Naturalist," "American Agriculturist," "Journal of Horticulture," "People's Journal," "Ægis and Gazette," "Rural New Yorker," "Revolution," "American Beekeeper's Journal," "Yale Courant," "Educational Bulletin," "Amherst Student," "Amherst Record," "Advocate of Peace."

Messrs. George Bruce's Son & Co., of New York, a copy of Specimen Book of Printing.

John S. Keyes, Esq., of Concord, 12 volumes "New England Farmer," and 2 of "Horticulturist."

Hon. Wm. B. Washburn, of Greenfield, 20 volumes Congressional Documents, and 25 copies U. S. Reports on Agriculture, for students.

E. Lewis Sturtevant, Esq., of Framingham, a fine collection of minerals.

George B. Emerson, LL. D., of Boston, 50 volumes of Agricultural books, and 24 varieties of tree seeds from California.

Messrs. Mason & Hamlin, of Boston, $400 discount on the price of a Cabinet Organ.

Prof. Louis Agassiz, of Cambridge, Bulletin Museum of Comparative Zoölogy.

Hon. Horace Capron, of Washington, D. C., numerous packages of seeds, for trial, and copies of the Bi-monthly and Annual Reports of the Department of Agriculture.

James S. Grinnell, Esq., of Washington, D. C., a valuable box of Patent Office and other Reports.

Thomas Field, Esq., of Northfield, one Shorthorn heifer, "Barre Belle."

The Winchester Rifle Co., of New Haven, Conn., two repeating and breech-loading rifles.

S. J. Parker, M. D., of Ithaca, N. Y., a pair Madagascar rabbits, strawberry plants and fossils.

Hon. C. L. Flint, of Boston, 100 copies Report of Massachusetts Board of Agriculture, for students.

Hon. Charles Sumner, of Boston, several packages seeds.

Agricultural Societies have paid the tuition and expenses of students of their own selection, as follows:—

Berkshire,	$54 00
Essex,	100 00
Franklin,	51 00
Hampden,	54 00
Hampshire,	51 00
Hampshire, Franklin, and Hampden,	57 00
Hingham,	150 00
Housatonic,	54 00
Mass. Society for Promotion of Agriculture,	216 00
Middlesex South,	54 00
Norfolk,	54 00
Plymouth,	108 00
Worcester	54 00
Worcester North,	54 00
Worcester South-East,	51 00

CATALOGUE OF HERD-BOOK ANIMALS BELONGING TO THE COLLEGE.

SHORTHORNS.

Mountain Lad. (8673.)
Young Acacia.
Yarico, 57th.
Arabella, 10th.
Peach Bud.
Aurora, 4th.
Fern.
Autumn Rose.
Barre Belle.
Susan Snap,—calf.
Emma, 3d,—calf.
Kate Hunnibee,—calf.
Two bull calves.

AYRSHIRE.

Colfax. (127)
Juno.
Lulie.
Rosa.
Beauty.

DEVON.

General Lyon. Devon Herd-Book, Vol. 2, No. 232.
Gem, 3d, Vol. 2, No. 502.
Winona, 2d, Vol. 2, No. 742.
Heifer calf.

JERSEY.

Enterprise.
Lucy.
Rosie.
Hattie.

SUMMARY OF METEOROLOGICAL OBSERVATIONS

For the Year 1870.

TAKEN AT AMHERST, MASS.,

By Professor E. S. SNELL, LL. D.

Latitude 42° 22′ 17″. Longitude 72° 34′ 30″. Elevation above the sea level, 267 feet.

REMARKS.

The weather in Amherst has been remarkable for the exceeding dryness of the last eight months of the year, and the consequent extreme heat of the summer.

The average amount of rain per month since May 1, was only 2.771 inches, the rain-fall for that month having been only 1.723 inches.

The mean annual rain-fall for the past ten years was 46.200 inches, while for 1870 the amount of rain and snow, measured as water, was only 39.700 inches.

The mean cloudiness of the ten years was .51 of the sky, while for 1870 the cloudiness was only .48.

The mean force of vapor for the ten years was .292 of an inch, and the humidity, 76; and for 1870 the former was .319, and the latter, 72.

The mean height of the barometer for the ten years was 29.712 inches; that for 1870 was 29.691 inches.

The mean temperature for the ten years was 46.87° Fahrenheit, while for 1870 it was 49.17°. The average temperature of each of the three summer months was above 70°, while in 1869 there was no month in the year with so high an average as 70°. The mean summer temperature of 1869 was 66.89°, while that of 1870 was 71.70°.

There was no frost for more than six months after April 1, and the mean temperature for the seven months after that date was 62.26°.

Indeed, we have no record of a season so warm as that of 1870, and it is a remarkable fact that the temperature did not fall to zero during the year. The winds have been unusual in respect to the amount and velocity from an easterly direction,—there having been two very severe and destructive gales from that quarter. In the month of June, one-half the wind was from the south-east. The winds of the ten years were distributed thus: From the north-west, 46 per cent.; from the south-west, 18; from the south-east, 24; and from the the north-east, 12. For 1870 the distribution was as follows: From the north-west, 43 per cent.; from the south-west, 15; from the south-east, 27; and from the north-east, 15.

During a portion of January, 1870, there was no frost in the ground, and the soil was in a fair condition for plowing, and this was successfully undertaken by several farmers in the vicinity of the college.

The spring flowers appeared about one week earlier than in 1869, as follows:—

Symplocarpus fœtidus, (skunk's cabbage), ...	Jan. 15.
Populus balsamifera, (poplar), ...	April 7.
Taraxacum Dens-leonis, (dandelion), ...	" 7.
Epigæa repens, (trailing arbutus), ...	" 9.
Ulmus Americana, (elm), ...	" 11.
Anemone nemorosa, (wind flower), ...	" 24.
Sanguinaria Canadensis, (blood-root), ...	" 24.
Fragaria Virginiana, (strawberry), ...	May 4.
Pyrus Malus, (apple), ...	" 8.
Sassafras officinale, (sassafras), ...	" 16.
Carya alba, (hickory), ...	June 1.

The hay crop was of excellent quality, but considerably lighter than it would have been, had more rain fallen in May and June. Early in July, pastures, except in low lands, began to fail, and the supply of fall feed was very limited. Oats and potatoes, especially the Early Rose and Bresee's Prolific, yielded a fair crop.

Corn, broom-corn, and tobacco, which withstand the effects of drought better than other crops, were nearly or quite as good as usual in the valley of the Connecticut; and corn fodder was never better.

The long continued dry, hot weather was very favorable to the sweet potato, which has been planted by many persons in the State the past season with very satisfactory results in most cases. Those grown in Amherst were large and of fine quality. Fruit of all kinds was ripened in great abundance, and was less affected by the drought, as to size, than might have been expected. Apples were very plenty, and grapes of all the hardy varieties were perfectly matured during the warm autumn.

SUMMARY OF METEOROLOGICAL OBSERVATIONS FOR 1870.

MONTHS.	THERMOMETER IN THE OPEN AIR.			RAIN AND SNOW.		CLOUDS.	WINDS. PER CENT OF TIME AND FORCE.				BAROMETER. BAROMETER HEIGHT REDUCED TO FREEZING POINT.			FORCE OR PRESSURE OF VAPOR, IN INCHES.			RELATIVE HUMIDITY OR FRACTION OF SATURATION.		
	Maximum.	Minimum.	Mean.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Mean amount of cloudiness.	Northwest.	Southwest.	Southeast.	Northeast.	Maximum.	Minimum.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
January,	54.3	5.0	30.78	5.872	13.0	6.0	40	20	21	19	30.380	28.820	29.786	.345	.041	.160	100	40	75
February,	55.0	6.2	25.34	5.247	14.0	5.4	64	8	15	13	30.267	28.922	29 582	.419	.037	.107	100	45	73
March,	50.5	6.5	30.88	2.709	19.0	5.6	55	-	29	16	30.234	28.991	29.627	.267	.051	.124	100	33	71
April,	78.0	35.0	48.26	3.701	0.5	5.6	26	13	25	36	30 153	29.368	29.688	.522	.094	.222	98	23	67
May,	82.4	42.8	58.27	1.723	-	5.3	32	9	35	24	30.028	29.167	29.658	.610	.111	.324	98	18	68
June,	93.0	53.5	70.45	2.728	-	5.6	25	15	50	10	29.888	29.316	29.676	.877	.275	.595	99	38	79
July,	91 2	54.5	73.55	2.526	-	4.3	30	26	41	3	29.839	29.389	29.687	.872	.337	.597	97	34	74
August,	91.3	47.0	71.11	2.828	-	4.0	34	31	25	10	30.073	29.426	29.692	.835	.237	.527	96	33	70
September,	85.5	40.0	62.32	1.752	-	3.6	42	12	25	21	30.165	29.330	29.823	.689	.191	.390	97	29	71
October,	71.5	26.0	52.02	4.494	-	4.5	46	22	20	12	30.286	29.056	29.753	.587	.108	.289	98	33	71
November,	61.0	24.7	39.10	3.278	-	4.3	65	8	20	7	30.132	29.195	29.632	.435	.058	.171	100	18	68
December,	47.0	1.0	28.00	1.840	3.0	3.0	56	18	14	12	*	*	*	*	*	*	*	*	*
YEAR,	93.0	1.0	49.17	39.700	4.95	4.8	43	15	27	15	30.380	28.820	29.691	.877	.037	.319	100	18	72

* No observations in December.

FINANCIAL STATEMENT,

JANUARY 1ST, 1871.

REAL ESTATE.

College Farm and Quarry,	$37,500 00
South College,	36,000 00
North College,	36,000 00
College Hall,	30,000 00
South Boarding-House,	8,000 00
North Boarding-House,	8,000 00
Durfee Plant-House,	12,000 00
Botanic Museum,	5,000 00
South Barn,	10,000 00
Farm House,	4,000 00
Four Dwellings and Barns, purchased with the estate,	10,000 00
Total Real Estate,	$196,500 00

FARM STATEMENT.

Value of Live Stock,	$7,809 00
of Vehicles and Implements,	2,479 00
of Produce on hand,	4,714 00
	$15,002 00

Total credits of Farm, including property inventoried, Jan. 1, 1871, credit for labor performed in grading, &c., and receipts from sales of produce and live stock,	$19,873 19
Total debits of Farm, including property inventoried, Jan. 1, 1870, and all expenditures for live stock, labor, implements, repairs, seed, fertilizers, &c ,	$21,409 69

FUND FOR MAINTENANCE OF COLLEGE,

In Charge of the State Treasurer.

The total amount received from the sale of the 360,000 acres of land given to Massachusetts, for the endowment of one or more colleges for the promotion of education in agriculture and the mechanic arts, is	$236,307 40
Of this amount, in accordance with the Act of Congress, was expended for a farm, ...	29,778 40

The investments of the fund, made by the State Treasurer, are as follows:

United States bonds, 5-20's, interest 6 per cent. gold, . . .	$50,500 00
" " " 10-40's, " 5 " " . . .	30,000 00
Massachusetts bonds, 5 per cent. gold, ...	24,000 00
" " 6 per cent. currency, ...	3,000 00
City of Salem bonds, 6 " "	55,000 00
City of Lynn bonds, 6 " "	25,000 00
Town of Milford bonds, 6 " "	14,200 00
Par value of bonds, ...	$201,700 00
Town of Plymouth note, ...	6,724 65
Total Fund, ...	$208,424 65
Annual Income of Fund at 6 per cent., ...	$12,505 48

Two-thirds of this is paid to the treasurer of the College, and one-third to the treasurer of the Institute of Technology.

Income of College from Fund, ...	$8,336 99
By the conditions of the gift, none of the income of the fund derived from the sale of land scrip can be used for the erection or repair of buildings.	
The Hills Fund of $10,000 for the maintenance of the Botanic Garden is in charge of the College treasurer, and at present yields an income of	500 00
Total Income from Funds, ...	$8,836 99

To this sum should be added the receipts of tuition and room-rent, amounting to $72 per annum for each scholar, and the receipts from the sale of the products of the farm and garden.

Dr. MASSACHUSETTS AGRICULTURAL COLLEGE *in account with* NATHAN DURFEE, *Treasurer*. Cr.

1870.			1870.		
Jan. 1,	To balance,	$7,485 90		By contingent fund,	$6,102 51
" 1,	Income from Hills' Fund,	500 00		salary account for quarter ending Dec. 31, 1869,	3,112 50
Mar. 16,	Cash from State Treasurer,	1,725 33		salary account for four quarters ending Dec. 31, 1870,	12,877 42
June 29,	Cash from State Treasurer,	3,114 49		farm account,	6,116 77
July 14,	Cash—State appropriation,	25,000 00		indebtedness of 1869 paid,	10,916 66
Dec. 31,	Cash—students' term bills,	13,204 56		students' board account,	4,746 61
" 31,	Cash—farm account,	3,004 78		term bill account,	4,171 36
" 31,	Cash—personal and contingent accounts,	281 78		extra instruction account,	1,893 25
				interest account,	1,138 31
				building fund account,	89 63
				personal accounts,	708 10
				laboratory and botanical accounts,	191 81
				Balance,	2,251 91
		$54,316 84			$54,316 84

Respectfully submitted.

NATHAN DURFEE, *Treasurer*.

I have examined the Treasurer's accounts, and find them correctly stated and accompanied by the proper vouchers.

HENRY COLT, *Auditor*.

REPORT

ON THE

PRODUCTION OF BEET SUGAR

AS AN

AGRICULTURAL ENTERPRISE IN MASSACHUSETTS.

By Prof. CHARLES A. GOESSMANN.

REPORT.

Among the various saccharine substances, which chemistry at present recognizes, are three of particular interest to the agriculturist, namely, milk sugar, grape sugar, and cane sugar. Milk sugar, which causes the sweetness of milk, is exclusively confined to this peculiar animal secretion, and constitutes in that of different animals from 3 to 9 per cent. Its application in an isolated form is quite limited, and its manufacture carried on mainly by the mountaineers of the Swiss Alps.

Grape sugar or glucose, which gives sweetness to the grape, is the most widely distributed of all saccharine substances. Most of our cultivated fruits derive from it, at least in part, their sweet taste.

It is the only one among the sugars previously enumerated, which we are able to produce by artificial means; its commercial importance, on account of its use for the production of alcohol and alcoholic liquors, as wine, beer, etc., and of sirups, is daily increasing. As our cheaper grains furnish the material, starch, from which grape sugar is mainly manufactured, its increasing production sensibly affects our home consumption of corn.

Cane sugar, which receives its name from its principal source, the sugar cane, is the kind which we commonly employ for household purposes, and is consumed in enormous quantities; while the number of plants which furnish it is quite limited. The sugar-cane, a few species of palm, the sugar-maple, the sorghum cane and the sugar-beet, are the plants which are turned to account for its manufacture. M. D. Dureau, in a report on the World's Exhibition of 1867, mentions that of the whole amount of sugar which has recently entered the various markets, 66.47 per cent is produced from the sugar-cane, 27.87 per cent from the sugar-beet, 4.29 per cent from the palms, and 1.24 per cent from the sugar-maple. The same authority

states that the whole amount of sugar sold in 1867 in the principal markets was 5,140 million pounds, besides eighteen million gallons of sorghum molasses.* The consumption of sugar is steadily increasing among civilized nations; in France it has more than doubled within the last thirty years; in England it has doubled within the last fifteen years, whilst in Germany, its consumption has increased threefold within the same period of time. Numerical statements like those of Dureau, respecting the total production, are therefore not surprising; in fact, if we should allow to the whole population of Europe the same liberal supply of sugar, required by the citizens of the United States (30 pounds per head), the total amount stated would scarcely suffice to meet one-half the demand. More than nine hundred million pounds of various grades of sugar, besides from fifty to sixty million gallons of sirup and molasses from sugar-cane and sorghum have been annually consumed of late, representing a value of nearly one hundred million dollars, of which about seven-tenths are first cost, and three-tenths government taxation.

Home Resources.

The sugar produced in the United States is far less than the amount consumed, leaving a heavy balance for importation. The production of sugar-cane in Louisiana and Texas, it appears from reports of Champonnois and others, never exceeded four hundred and fifty thousand hogsheads, besides twenty thousand gallons of molasses; the maple-sugar production may have reached in favorable years from twenty to twenty-five million pounds; the sorghum plant has thus far yielded, with but a few exceptions, only molasses,† whilst the cultivation of the sugar-beet for the manufacture of sugar, has just begun to attract attention as worthy a more thorough trial in various parts of the country.‡ In presenting the above figures concerning our home production, I have chosen as far as the sugar-cane cultivation is concerned, the results of 1861, the most favorable year on record. Glancing over the early history of the

* The home consumption, particularly in the East Indies, is apparently not estimated, for the home consumption of cane-sugar obtained from palms, is set down as 90,000 tons. (See Hunt's Commercial Review, Vol. 39, Nov., 1858, No. 5.)

† Mr. B. Moore, of Bloomington, Ill., and others, have produced a large quantity of crystallized sorghum-cane sugar.

‡ The first attempt to produce beet-sugar within the United States, is credited to David Lee Child, of Northampton, Mass., who made about 1,300 lbs. of sugar in 1838.

sugar-cane in Louisiana, we find that the large production of sugar, conceded to her above, proves to be based on an exceptionally large crop, and gives by no means a correct idea of her past contribution to our home product. The sugar cane was first introduced into Louisiana in 1751; M. Dubreuil established the first plantation in 1758; from 1828 to 1843, its average produce per year has been about 82,000 hogsheads (90,000,000 pounds) of sugar, besides five to six million gallons of molasses; from 1844 to 1857, its annual produce averages two hundred and forty-one thousand and eight hundred hogsheads (each 1,100 lbs.), or 265 million pounds of sugar, with about sixteen million gallons of molasses; in 1854, there were one thousand four hundred and eighty-one plantations under cultivation, whilst in 1857, but one thousand two hundred and ninety-nine plantations are reported. The last report (1869) of the National Agricultural Department at Washington, D. C., states on the authority of M. Bouchereau, that one acre yielded during the past year 1,350 pounds of sugar, worth ten cents per pound, besides seventy gallons of molasses, worth sixty cents per gallon; and that improved lands fit for sugar-cane cultivation might be bought for from $25 to $40 per acre.

While the sugar-planters of Louisiana, a few years before the late war, thus apparently struggled to hold their slowly gained ground, we cannot help being struck by the prominent position which the sugar-cane cultivation acquired during the same period of time in the neighboring island of Cuba, which furnished for exportation from eleven to twelve hundred millions of pounds, about one-third of all the sugar that enters the markets of the United States and Europe. Unfavorable legislation with us is frequently cited as a cause of the results in Louisiana. Unsettled conditions regarding leading principles of political economy, no doubt, act most seriously on industrial enterprises, which require time for their healthy development; how much such influence may have interfered here, I do not propose to discuss, but shall confine myself to the exposition of a cause which has much to do with the past results of the Louisiana sugar-cane cultivation. A close examination of the statistics of the annual production of sugar in Louisiana, for over forty years past, leaves scarcely a doubt about the fact,

that unfavorable climatic influences—as early frosts, and the consequent serious limitation of the harvesting season, must have interfered with the most profitable cultivation of the crop.

The fluctuations in the annual produce of sugar during successive years are so large and of so frequent occurrence, that any other assumption can scarcely account for it. Thus we have—

In 1834,	100,000 hogsheads.	In 1846,	140,000 hogsheads.
1835,	30,000 "	1851,	236,000 "
1838,	70,000 "	1853,	439,976 "
1839,	115,000 "	1856,	73,976 "
1843,	100,000 "	1860,	228,758 "
1844,	200,000 "	1861,	459,410 "

To rely on the production of one crop exclusively without abundance of ready capital is hazardous, even in exceptional cases, where the special character of the soil and of the climate, or the peculiar condition of the markets, seem to secure a monopoly, for these conditions are at the present time in the majority of cases but temporary. Wherever large gains are to be secured, competition will sooner or later enter the field. The cane-sugar industry of Louisiana, judging from past experience, cannot stand in unrestricted competition with that of the islands of the West Indies; but a judicious rotation of crops, and the introduction of other sound principles of modern farming, may produce better results in the future.*

Our production of maple-sugar is of little consequence as far as available quantity is concerned, and still less reliable in regard to its annual yield; since an early spring with warm nights may reduce it to a mere trifle. An increase of maple-sugar production is scarcely to be expected, and its chances are daily diminishing. Many of our barren, rocky hillsides might furnish suitable grounds for maple-groves, yet before broad-leafed trees will flourish, it is probably necessary that the exhausted ele-

* The production of sugar from one acre of sugar-cane differs widely, and may be greatly increased, by the adoption of rational modes of cultivation. Upon Reunion 1,056 lbs. sugar are stated to be the annual results per acre, while upon Java, 4,045 lbs. are raised upon the same area. The great success upon Java is ascribed to the adherance to a judicious system of rotation, but one-fifth of the lands under cultivation being planted at one time with sugar-cane, the cane changing its place every two years, and the weeds upon the land being frequently burned, to destroy parasites, etc.

ments of fertility be restored by the growth of one or more generations of pines.

Our production of the sorghum plant, although spreading steadily in some portions of the country, has not yet received that attention in those localities, which, on account of a warm and long season, are particularly qualified to reap the full benefit of its cultivation. In a paper presented to the New York State Agricultural Society at their annual meeting in 1861, and printed in their annual report of that year, I stated the results of a chemical investigation carried out by me in 1857, concerning the fitness of the sorghum cane for the manufacture of sugar and of superior sirups. These statements have been confirmed, as far as its yield of a good quality of sirup is concerned; but the manufacture of sugar has not been tried to any extent, although there is no substantial reason why within some of the Southern States with their favorable climate, a part of its sugar might not be advantageously secured in crystals. A proper defecation of the sorghum juice before its concentration would doubtless accomplish that result. In making these statements here, I do not intend to assert that most of our Northern, and particularly our North-western States can profitably engage in the production of sorghum sugar. Localities liable to early frost and short seasons had better confine themselves, if at all engaged in sorghum cultivation, to the manufacture of sirups, for unripe cane is entirely unfit for the manufacture of crystallized sugar. The Middle and some of the Southern States have apparently not sufficiently appreciated the value of this crop. Associations between neighboring farmers for the purpose of supporting one cane-mill in common, no doubt, would reap handsome profits. Quick working of the ripe cane is essential to success, for there is no practical way as yet proposed, by which the sorghum cane may be preserved unchanged after it has attained its ripeness.

In view of these present conditions and future prospects of existing home resources of one of our most important articles for daily comfort, we must regard it as peculiarly proper that public attention is turning more and more seriously toward the question, whether with intelligent management the production of beet sugar as an industrial enterprise can be profitably undertaken in Massachusetts, as it has been in many countries of

Europe. Having witnessed personally the working of the sugar-cane upon the island of Cuba, and in Louisiana, and being also somewhat acquainted with the beet-sugar industry of Europe, and the treatment of sugar solutions for refining purposes, I do not hesitate to state, that the sugar-beet as a mere sugar producing plant is inferior to sugar-cane; in fact, if it were possible to cultivate advantageously the best sugar-beet alongside of the sugar-cane, bestowing at the same time equal care on the cultivation of both plants, and on the treatment of their juices, they could be scarcely considered rivals. Yet, to-day, the beet-sugar manufacture is looked upon in Europe by agriculturists and by sugar manufacturers as a decided success.* England, even with her great facilities for importation, and her favorable commercial relations with cane-sugar producing countries, is hastening of late to add the beet-sugar manufacture to its home industry. English agriculturists have had for years occasion to notice the highly prosperous condition of the farms in beet-sugar producing districts of Germany, France, and elsewhere; while English capitalists begin to believe in the sound foundation of the new business, when they notice the steady increase of beet-sugar importation into England, amounting in the year 1867 to a value of £1,600-000.

However different the views of the friends of the beet-sugar interest may have been at various times regarding its financial success as a mere industrial enterprise for a cheaper home manufacture of sugar, they all agree at the present day on one point, namely, that in connection with agriculture it has proved to be one of the most important, and at the same time, most successful attempts to stimulate the introduction of sound principles into agricultural pursuits, to develop, consequently, agriculture, and to promote a healthy feeling of a common interest between agriculture and manufactures, between capi-

* The beet-sugar manufacture in Europe amounted in 1859 to 812,113,000 pounds; in 1869 to 1,256,462,300 pounds, of which was produced—

By France,	32 per cent.
German Confederation,	28.5 per cent.
Austria,	11.8 per cent.
Russia,	14.83 per cent.
Belgium,	5.92 per cent.
Poland,	2.81 per cent.
Holland,	0.89 per cent.

tal and labor. Improved farm management and unusual progress in the modes of separating the sugar at a lower cost went hand in hand. European agriculturists have accomplished this thrifty union of mutual industrial and agricultural interests, only by devoting themselves with almost unrivaled perseverance to the task of producing a sugar-beet which contains the largest possible amount of sugar in the most favorable condition for extraction. The solution of the problem, whether beet-sugar manufacture can succeed with us, as a paying enterprise, will prove to depend here, as has been the case in Europe, on the interest which intelligent agriculturists and agricultural chemists will take in raising a suitable sugar-beet; for the quality of the root controls to a large degree the financial success of the industrial enterprise. A mere high percentage of sugar in the beet-root is not the sole requirement, although a most important one, but the production of a beet which contains the largest possible amount of sugar with the smallest possible percentage of foreign substances, whether saline, nitrogenous, or indifferent, non-nitrogenous organic compounds, for practice has established beyond doubt, that for every percentage of foreign admixture, about one and a half per cent of sugar in the juice will be rendered uncrystallizable, and thus converted into a less valuable molasses. It is of the utmost importance that the difficulties to be encountered be well understood, for a temporary check caused by want of proper precaution in producing a suitable beet, or providing the necessary apparatus, or oversight in the general management, would be deplorable, considering the benefits to be gained for agricultural development alone, in case the experiment should succeed. It is then to our intelligent farmers these few pages are addressed, for the purpose of aiding in the dissemination of facts, which have been instrumental in the development of the sugar-beet cultivation and the beet-sugar manufacture. Influenced by such views, I proposed a year ago to enter upon experiments concerning sugar-beet cultivation upon the college farm, and procured a variety of seeds from successful sugar-beet cultivators in Germany, believing that much was gained by having the best to begin with. The first year's crop has been gathered, and the percentage of sugar of each of the thirteen kinds ascertained. Beyond that point no experiments

have been made; for as it was too late to control a proper manuring of the land used, I left the determination of foreign admixtures, which, in quality and quantity are decidedly influenced by the kind of manure applied, to another season, when the soil can be properly prepared and planted with carefully selected seeds. The results of the past season, being for the reason just referred to of a mere introductory character, will follow as an Appendix to these pages.

THE CULTIVATION OF SUGAR-BEETS.

The rules, by which beets are successfully raised for feeding purposes, do not apply to a successful production of the beet for sugar. In the first case, quantity is the main aim; in the second, besides quantity, a good quality is essential. A good sugar-beet is expected to contain not less than twelve per cent of sugar, a small percentage of saline substances, and the least possible amount of nitrogenous and non-nitrogenous constituents. The more nitrogenous compounds are present, the less sugar will be noticed; for they exert a controlling influence on the formation of sugar in the growing beet-root. The saline substances, on the other hand, do not affect injuriously the formation of sugar; yet, they place it under very disadvantageous conditions, as far as its final separation in a crystallized state is concerned; they favor the production of molasses and thus increase the manufacturing expenses. The history of the beet-sugar industry of later years is not without many illustrations of these damaging influences. Some late experiments in this country, no doubt, owe their failure, in part at least, to the fact, that virgin soil, rich in vegetable mould and saline constituents, has been used for the cultivation of the sugar-beet. Judging from analogy, we cannot but consider the reported gigantic roots and unusually large crops per acre as unfavorable features of some recent attempts in beet-sugar manufacture. The common mangel is no substitute for the sugar-beet in the production of sugar, while the latter is highly valued for feeding purposes and becoming daily more popular.

Among the various kinds of sugar-beets at present cultivated in Germany, the Silesian white sugar-beet (Achard's beet) is almost exclusively employed. Two of its sub-varieties, the pear-shaped white Silesian beet, with somewhat drooping leaves,

(which is a cross-breed from the wedge-shaped Silesian white sugar beet and the Magdeburg chicory beet), and the Quedlinburg variety, with pinkish colored skin and red lines in the centre leaves, are particularly valued. The latter requires the richest soil. The French Vilmorin sugar-beets, on account of their superior saccharine property are also frequently raised ; yet as they are more liable to degenerate in the pits during the winter season, they are only cultivated to a limited extent, and are worked before frost during the latter part of September and October. The sugar-beet in its present state, a child of cultivation, is a variety of an unsightly biennial plant, *beta maritima*, which grows wild along the coast of the Mediterranean, in south-western Europe. A comparison of the following analyses of the ash constituents of the wild and the cultivated plant gives some idea to what extent a systematic cultivation for particular objects, aided by climate and soil, may affect the normal mineral constituents of a plant. The wild beet-root may be called a soda plant, while the cultivated sugar-beet is decidedly a potassa-plant.

Wild Beet-root. (WAY.)

Potassa,	30.1	
Soda,	34.2	
Lime,	3.1	
Magnesia,	3.2	
Chlorine,	18.5	
Sulphuric acid,	3.8	
Phosphoric acid,	3.5	
Silicic acid,	3.6	
		100.00

Cultivated Sugar-beet. (BOUSSINGAULT.)

Potassa,	48.9	
Soda,	7.6	
Lime,	8.8	
Magnesia,	5.5	
Chlorine,	6.5	
Sulphuric acid,	2.0	
Phosphoric acid,	7.6	
Silicic acid,	13.1	
		100.00

It is well known, that, as a general rule, the various mineral constituents of a plant are indispensable to its growth, so that, if any one is wanting, the rest are thereby rendered incapable of supporting it. Our whole system of manuring, and even of rotation, rests upon this premise, and practical experience manifestly confirms it.

The composition of the ash constituents of the highly cultivated sugar-beet, compared with that of the wild beet, furnishes us with a striking instance as to what extent elements of a similar chemical character, for instance, potassa and soda, may be substituted for each other. We may also notice, however gradually such substitution may have been accomplished, that it inevitably affects the normal physiological processes going on in those plants which are subjected to such treatment. Whatever favors abnormal growth in plants surely aids in hastening on their premature unfitness for propagation, and their final extinction. A comparative study of our garden plants regarding their ash and other constituents, in their wild and cultivated state, would furnish us most likely with numerous instances of differences similar to those noticed in the case of the sugar-beet, and investigations of that kind could not but point out to us very important facts concerning the most advantageous selection of special manures for the production of a desired abnormal growth of our cultivated plants. Louis Vilmorin, the celebrated French gardener and seedsman, states that he raised, by proper selection, sugar-beets which contained in their juice not less than 21 per cent. of sugar, thus surpassing in sweetness the juice of the sugar-cane.

Selection of Varieties of Beet.

The successful cultivation of the sugar-beet begins with the selection of seed beets. Vilmorin's views on this subject are considered of great weight; a detailed exposition of his rules may be found in the Journal d'Agriculture Pratique, No. 5, 1858. He advises the selection of healthy, well-shaped beet-roots of from 1½ to 2 pounds weight, those, which with a large yield, show the most rings of leaf marks are preferred,—the specific gravity of their juice ought not to be less than 1.05; those which contain a juice of from 1.06 to 1.07 specific gravity are of superior character; seed-beets ought not to be taken from a

soil which for the first time is turned into use for the production of sugar-beets, and the seed-beet fields ought to be kept separated from the general sugar-beet fields.*

Soil for Sugar-Beet Cultivation.

The best soil for the cultivation of sugar-beets is a mellow, deep, sandy loam with a free and permeable subsoil,—a soil named by German agriculturists a rich, first-class barley soil. A sandy loam, if deep and rich in well decomposed organic matter, is preferable to a clayish soil, for the latter becomes too compact and hard in a dry season, particularly after heavy rain showers, and thus frequently interferes with the growth of the fleshy roots ; and in wet seasons it produces a watery beet of inferior saccharine properties. In case the subsoil is not perfectly free, under-drainage becomes indispensable. A stony soil, or a thin surface soil, with gravelly subsoil, or a deep virgin soil with large quantities of half-decayed vegetable matter, are very objectionable ; and stagnant waters cause the premature decay of the roots at their lower termination.

Favorable physical properties of the soil are of the first importance, for fitness of the soil, as far as a necessary amount of plant food is concerned, may be secured by a carefully selected system of rotation, supported by a proper selection of special manures. Inferior kinds of soil, may, to a certain degree in some exceptional cases, answer for beet-sugar cultivation, yet they ought not to be solely relied upon as a safe basis for beet-sugar manufacture. A moderately warm and moist climate seems to be best adapted to this crop ; the northern sections of Germany and France being considered more successful than the southern parts of those countries. This observation may find its confirmation in the United States. Whether a change from Wisconsin to California merely on account of a warm climate would be a judicious move, future experience may teach,—but past experience does not point in that direction. The sugar-beets raised in southern portions of Europe have been found to contain more saline constituents than those raised in northern sections, a circumstance which must counteract their superior richness on sugar. A careful change to deep plowing is for

* The amount of beet seed raised per acre, varies from 12,500 to 25,000 pounds.

obvious reasons highly recommended, provided the subsoil proves of a fit quality. In no case is the soil to be plowed to a less depth than eight inches; from ten to sixteen inches and deeper being desirable. Wherever deep plowing is undertaken for the first time, it is done during the fall, and the lands are immediately afterwards well manured. The rules for preparing the soil may be summed up as follows: Manure in the fall and plow the manure in deep; use only well rotted compost, if you are obliged to manure in the spring; begin the work in autumn at any rate, and turn the soil two or three times; do not work the soil when wet; pulverize it with the best implements, and as soon as possible; let not much time be lost between the last mechanical operation and the seeding.

Stable manure is the basis of the whole system of manuring; commercial or artificial manures are only relied on as an aid. For this reason sugar-beets are usually raised as second crop, giving a chance for a thorough disintegration of the stable manure; the effect of the latter is supported in the second year previous to the planting of the sugar-beet, by a special commercial manure. The condition and the composition of the soil, quite naturally, control the whole system of manuring. As the soil in both respects will differ more or less, practical experience does not point out any one manure, which will answer under all circumstances; yet sufficient is known to assert what kind of manure has a good effect, and what has a bad effect on the sugar-beet, as far as the percentage of sugar and its final successful separation are concerned. The production of sugar being the main object, and on account of its high price affecting most decidedly the balance sheet, it is but natural that the agriculturist has now and then to compromise in the interest of the sugar manufacturer. Large crops of watery sugar-beets are not economical, where, as for instance in Germany, the beet-root is taxed; in France, where the sugar resulting from the sugar-beet is taxed, spring manuring is more freely resorted to.

Plants differ less in regard to the various kinds of food they need, than in regard to the quantities of each kind. Stable manure and plant ash are for this reason the only universal manures we recognize; the former is preferable to the latter, on account of its decided effect on the physical condition of the soil. The beet partakes largely of atmospheric food, and as the

proper physical condition of the soil increases its disposition to absorb atmospheric plant food, we find that stable manure, and green crops turned under, are the best fertilizers; the only precaution recommended consisting in the advice to apply them in time to have them disintegrated before the beets are planted. The successful sugar-beet cultivator adheres to the rule to sell nothing without replacing it in some form or other, except what he has drawn from the atmosphere, the sugar,—considering almost everything else part of his real estate, which he cannot dispose of without injuring its value. Whatever he sells, besides sugar, is merely a matter of exchange; the mineral constituents, and to a certain extent the nitrogen, which the articles sold contain, whether in the form of milk, grain, or live stock, produced upon his farm, he brings carefully back, either by buying fertilizers, or better, by buying hay to manufacture the manure on his grounds.

We find no definite relation between the organic portion of plants and their mineral constituents; yet we know that an abundant supply of both nitrogenous and mineral substances controls the amount of oxygen, hydrogen, and carbon, absorbed for the formation of the organic constituents of plants, and that the available amount of these substances thus manifestly decides their final annual growth. It is thought best for this reason to calculate the amount of manure required for the production of a satisfactory crop from the quantity of nitrogen and mineral constituents, which a full crop contains. The form in which we apply the manures usually varies widely. They are rarely of a homogeneous nature, and require, therefore, more or less time for disintegration and final absorption; larger quantities of manure are consequently applied in starting a crop than it actually requires. It may be of interest to some to notice a few of those figures, which are commonly used as bases for the calculations of the time required to reap the full benefit of various kinds of manure.

	1 year.	2 years.	3 years.	4 years.
Stable manure,	50 per cent.	25 per cent.	15 per cent.	10 per cent.
Flour of bone,	30 "	30 "	25 "	15 "
Oil cake,	50 "	30 "	20 "	15 "
Peruvian guano,	60 "	30 "	10 "	15 "

Pulverized commercial manures, as a general rule, are expected to work quickly, as slow action would seriously enhance their cost, adding interest of outlay to the capital; and most of them are designed to supply only special wants, and aid thereby in the production of large special crops. They therefore, if not proportionately supported by stable manure, green manuring, and a judicious rotation of crops, hasten on the exhaustion of the soil or general mineral plant-food. In some cases, as with guano, their effect depends, in an undesirable degree on the weather, whether dry or wet. Special manures occupy for these reasons a subordinate position. Potassa and phosphoric acid are, strictly speaking, the only plant constituents which have to be bought in consequence of the extensive stock-feeding usually connected with the farm management of sugar-beet cultivation for manufacturing purposes, particularly in cases where the molasses is sold, which contains a very large proportion of the soluble saline constituents of the beet-roots. Having attempted to enumerate some of the rules by which practice should be guided, it may be but proper to speak somewhat more in detail of the special effects of some of these manures. Fresh barnyard manure, particularly of horses and sheep, or liquid stable manure, or poudrette, and all manures containing uric acid are decidedly objectionable in the spring preceding the planting of the sugar-beet, for they induce an excessive growth of the leaves, shortening thereby the time for the ripening of the beet-roots, while favoring an increase of their nitrogenous constituents. They also cause a large absorption of saline constituents. In case barn manure has to be applied during the spring preceding the raising of the sugar-beet, cow manure is considered the least objectionable, but well-rotted compost is

preferred. Guano and oil-cake, without any admixture of superphosphate of lime, act similarly to the most objectionable fresh stable manures. Saline compounds, as saltpetre, salt, Stassfurth manure-salt, &c., increase the quantity of beets, yet render them, if applied freely, rich in saline constituents. A mixture of one hundred and thirty pounds of Peruvian guano, and three hundred to four hundred pounds of superphosphate of lime per acre, or Chili saltpetre with superphosphate of lime, or wood ashes, or flour of bone, or well-rotted bones with wood ashes, are considered the best special manures for the production of superior sugar-beet. Green manuring, if applied in time, is highly recommended on account of its effects on the physical properties of the soil. Judicious selection of crops for rotation is most carefully resorted to in the interest of economy of manure and an undiminished productiveness of the soil. To render an efficient system of rotation possible, but one-fourth of the entire area under cultivation is planted annually with sugar-beets. In case a rotation of five or six years is possible the results are still more satisfactory. In the absence of a large farm, a number of smaller ones may thus successfully support a beet-sugar factory; and the soundest basis for a sugar-beet establishment consists in making arrangements by which the farmer is to have an interest in the produce of sugar. To engage merely in the cultivation of the sugar-beet for supplying existing factories is, however, considered a paying business, particularly if the farmer secures to himself in part at least the vegeetable refuse, as press-cake, &c., for stock feeding.

Planting of the Seed and Treatment of the Sugar-Beet.

The seed are planted by hand or by machine; theoretically from two to three pounds would be necessary for one acre, but in practice from fifteen to seventeen pounds are used. The seeds, after being soaked in water, if planted by hand, are placed usually at a distance of fourteen inches apart; if sowed by machine (of Garret's patent) they are dropped about eight inches apart in rows about twenty inches apart, which allows one horse with implement to pass between. In the latter case from 28,500 to 30,000 plants could be raised upon one acre. A larger space around each plant favors an excessive enlargement of the roots, a result not at all desirable, for large beets are usually watery.

A beet-root from one to one and one-half pounds is preferable to those from two to three pounds. Every common beet seed, containing by its natural construction from two to three germs, will produce as many plants, of which the strongest is left, whilst the rest are pulled up or otherwise destroyed in due time. The process of thinning out the plants takes place as soon as the roots have reached a length of from three to four inches, and, if possible, shortly after a rain, to prevent the loosening of the soil around the specimen left. A transplanting of sugar-beet plants from a separate bed to the lands for final cultivation is rarely resorted to; it is only recommended to fill out the gaps produced by the failure of seeds. Whenever this failure acquires any considerable proportion in the beet fields, a re-seeding is preferred, provided the season has not too far advanced. The soil around the young plant should be frequently loosened by proper implements (every two or three weeks), and the roots kept carefully covered, until the leaves have acquired their proper development early in June. Such treatment destroys the weeds and increases the hygroscopic and general absorptive properties of the soil, and thus favors highly an undisturbed, early and rapid development of the leaves. The latter, it is asserted, exert a controlling influence on the formation of sugar. M. Vilmorin considers a large number of rows of leaf marks, as previously stated, an essential property of a good sugar-beet. The leaves absorb as a general rule atmospheric food in proportion to their number and size. The sooner they acquire a good size, and the more numerous they are, the better are the chances of a copious formation of sugar, for this apparently depends to a great degree on the supply of atmospheric food. There are three distinct periods in the growth of the beet, viz.: the development of the leaves, which closes usually within the first half of June; the formation of the roots which is accomplished by the middle of September or first part of October; and, finally, the production of the seeds which takes place in the second year. The ripeness of the roots is indicated by a change in the color of leaves from a deep green to a yellowish tint. Those varieties which show a particular inclination to grow out of the soil are considered inferior. As soon as the leaves have reached their size, which happens in ordinary years usually in the fore part of June, the loosening of the soil and the cover-

ing up of the beet-roots ceases, leaving them undisturbed in their growth. To convey some idea concerning the peculiar features in the growth of the sugar-beet plant, I insert here some of the results of an interesting investigation in this direction by Dr. P. Bretschneider. The weights are in grammes, one gramme being equal to 15.43 grains:—

DATE.	Weight of the Root.	Weight of the Leaves.	Proportion between Root and Leaves.	Percentage of Sugar.
June 12, . . .	0.2005	-	-	2.13
21, . . .	5.3000	-	-	4.17
July 9, . . .	78.3000	286.	1 to 3.65	4.99
16, . . .	109.600	226.	1 to 2.06	8.86
29, . . .	166.	224.	1 to 1.34	-
Aug. 8, . . .	124.	106.	1 to 0.56	11.27
26, . . .	228.	121.	1 to 0.53	11.52
Sept. 19, . . .	586.	346.	1 to 0.59	11.45
19, . . .	169.	38.	1 to 0.22	10.80
19, . . .	204.	50.	1 to 0.25	13.15

The harvesting of the sugar-beet root begins, when the outer leaves turn yellow and dry, which in different seasons and localities may vary from the fore part of September to the first of October; the past season being with us unusually dry and warm caused a somewhat premature dying out of the leaves upon our experimental field. The gathering of the leaves, even in part, at any preceding stage of the growth of the plants, is seriously objected to, for it affects most decidedly the final yield of sugar. Nature, in its wonderful economy of matter and force, always provides for the continuance of species under the most advantageous conditions, storing up in some of the organs of plants under the influence of a favorable summer temperature a maximum of such compounds as will enable them to develop their organs for propagation almost independent of outside assistance. The flowers and subsequently the seeds draw upon

the food accumulated in roots, stalks and leaves, and the seeds themselves again store up an amount to enable the embryonic germ to provide itself with such organs as will fit it to fulfill its mission in the production of a new plant. Sugar is undeniably one of those substances which are required to support the beet-root plant in this last stage of growth.

The amount of sugar in the sugar-beet is largest when the root has just attained its ripeness; subsequently, it diminishes gradually in consequence of advancing growth. To preserve undiminished the maximum percentage of sugar till the time of manufacture is somewhat difficult. There is no such thing in nature as absolute rest. If it were practicable to keep the beet-root frozen from the beginning to the close of the manufacturing season, it might prove to be the most efficient mode, so far as the preservation of sugar is concerned. The manufacture of the sugar begins usually in the latter part of September, and the beet-roots are daily carried in such quantities from the fields as the factory can dispose of. Those varieties, like the Vilmorin beets, which do not keep well in the pits over winter, are first gathered and worked up. As soon as frost becomes imminent, all the roots are gathered after the removal of the leaves, which operation is carried on upon the fields. They are then buried in suitable pits without loss of time. The beets are raised out of the soil by means of forks, and the leaves cut off with sword-like knives about one-half to one inch from the root. To cut off the top of the beet-roots from those which are to be kept over winter is disapproved of. The use of the plow in harvesting is also objectionable on account of frequent laceration of the roots.

The mature roots after being freed from the leaves in the manner just described, are with the adhering soil laid carefully into shallow pits about six feet long by three feet wide, and from four to five feet in depth. These are, finally, covered with soil to protect them against frost. Small pits of the size just described are preferred, for they allow a better control of the temperature than large pits, which frequently suffer from an undesirable increase of heat, causing the growth of leaves or degeneration by decay. The covering of soil is gradually increased in thickness with the advancing season, amounting usually to a final thickness of three feet, and this is sometimes

rendered more efficient by a thin outer layer of stable manure. To secure a uniform moderate temperature is the sole object of these proceedings, and pits beginning to heat, are worked up without delay. The pits must be located upon very dry land on or near the beet fields, and in such a position that no accumulation of water can injuriously affect them.

To give some idea about the changes which a good sugar-beet undergoes in the pits even under quite favorable circumstances, I insert the following statement of H. Rake. The same kind of beet-roots contained—

In October, 1862:

Cellulose,	3.49
Water,	82.06
Cane sugar,	12.40
Grape sugar,	–
Mineral constituents,	0.75
Albuminous and extractive substances,	1.30
	100.00

In February, 1863:

Cellulose,	2.52
Water,	84.36
Cane sugar,	10.60
Grape sugar,	0.65
Mineral constituents,	0.63
Albuminous and extractive substances,	1.20
	100.00

Whenever the roots begin to rot the sugar is lessened; the loss due to the sprouting of the leaves may amount to two per cent more than the preceding analysis states.

Yield of Sugar-Beets.

The numerous varieties of beets differ widely in regard to their annual yield, independent of the conditions of season, upon the same soil and under the same treatment. Whilst common mangels have been raised upon a suitable soil, in exceptional cases, at the rate of from ninety-four to one hundred

and ten tons per acre, the sugar-beet never yields at anything like such a rate. The following statement respecting the yield and amount of sugar obtained from three kinds of beets is quite interesting and suggestive regarding the important question, what kind of beet roots are the most desirable for cultivation for the manufacture of sugar.

NAMES.	Annual yield of Roots per acre.	Percentage of Sugar.	Amount of Sugar in the entire Root Crop.
Metz (fodder beet), . .	86,457 pounds.	4.5 per cent.	3,890 pounds.
Imperial (sugar-beet), .	59,613 "	10.51 "	6,265 "
Silesian White (sugar-beet),	52,787 "	13.64 "	7,200 "

These few numerical statements teach most decidedly, that mere quantity will not insure success for the beet-sugar interest. We find in practice as a general rule that the mean annual yield of sugar-beets is less than in the cases cited. In Silesia, the crop averages from 18,000 to 19,000 pounds per acre, and the beet juice itself is expected to contain throughout the entire sugar-making season from 11 to 13 per cent of sugar, which indicates that scarcely any roots with less than 12.5 per cent of sugar are worked in that district. In Saxony, from 23,500 to 24,000 pounds are obtained per acre, and, in exceptional cases, even as high as from 30,000 to 31,000 pounds are reported. In France, where the sugar resulting, and not the roots used for its manufacture, are taxed, the annual yield is larger than in Germany, one acre yielding there from 38,000 to 40,000 pounds of roots. Yet a larger final yield of sugar is claimed from one acre in Germany than in France.* The cost of production in Germany is set down at from 21 to 22 cents per hundred pounds of sugar-beet roots.

Those who sell their sugar-beets at the factory, receive from

* In Germany 100 pounds of sugar-beet roots are taxed (8 sgr.) 19.44 cents (1869). In France every (52 kilogrammes) 114.4 pounds of beet sugar are taxed (13 francs and 75 centimes) 2.66 dollars. Every 1,000 kilogrammes or 2,200 pounds of sugar-beet roots yield on an average (52 kilogrammes) 114.4 pounds of sugar in the form in which it is taxed. (Walkhoff.)

25 to 27 cents per hundred pounds, together with one-half of the vegetable refuse or press-cake.

Not unfrequently, separate contracts are made for furnishing small beets not exceeding two pounds in weight. The sugar-beet cultivation usually becomes a prominent feature of agricultural industry in the vicinity of beet-sugar factories, for although the manufacturer of sugar is, as a general rule, to some extent at least a producer of beets, he rarely limits himself to the amount of his own produce. He finds it profitable to purchase a certain quantity, if for no other reason, in order to be enabled to cultivate his own lands on a liberal system of rotation. He, also, frequently retains one-half of the press-cake and other refuse resulting from the working of an additional amount of beet-roots, for stock feeding and manuring purposes.

Yield of Juice.

The sugar-beet contains about 82 per cent of water, and 80 per cent of its juice may be obtained by subjecting the crushed beet to a powerful pressure. The relation of the power applied to the quantity of juice obtained may be inferred from the following statement of Walkhoff:—

By 50	pounds of	pressure	to the	square	inch,	60	per cent.
80	"	"	"	"	"	64	"
400	"	"	"	"	"	75	"
750	"	"	"	"	"	80	"

The press-plates are made 14 inches or more square, and 24 pounds of pulp for every 100 square inches of press surface is considered the best proportion. The roots are usually changed into a pulp by circular saws fastened upon two hollow iron rollers running in opposite directions. Water is added (from 15 to 30 per cent) while preparing the pulp to reduce the amount of sugar left in the press-cakes. By means of this and numerous other devices from 80 to 87 per cent of the actual juice in the beet-roots is secured. The profitable addition of water is limited by the expense arising from the evaporation of a diluted juice.*

* One hundred pounds of coal are required for the evaporation of 500 pounds of water, in the course of beet-sugar manufacture.

The extra expense necessary to procure more than 80 per cent of the juice diminishes largely its value, nevertheless improved methods are constantly sought and are doubtless attainable.

The press method and Roberts'* modification of warm and cold maceration of the fresh beets have apparently the warmest advocates. It would be a vain attempt on my part to treat here in a becoming manner on these questions. I propose to leave that task to some future occasion, when the manufacture of beet-sugar will be discussed. The supply of labor, fuel, and water, the condition of the sugar market, &c., control, as every manufacturer is aware, in such a degree the choice of apparatus and modes of operation, that very little information could be gleaned from a general discussion without some detailed explanation. To the farmer, the vegetable refuse, as press-cake and like substances, is of prime importance, and the various modes of abstracting the juice from the beet roots affect him only in so far as the value of the refuse for feeding purposes is concerned. A comparison of the composition of the juices obtained by means of a powerful hydraulic press and by Roberts' maceration, (or the dialytic mode), can aid in understanding this question of which I shall have to treat somewhat more in detail hereafter:—

I.

Beet juice procured by the aid of a hydraulic press contains:—

Sugar,	12.410	per cent.
Potassa and soda compounds,	0.458	"
Lime and magnesia,	0.187	"
Nitrogenous substance,	1.418	"
Non-nitrogenous organic substances,	1.048	"

II.

Beet juice procured by Roberts' diffusion apparatus with an addition of 15 per cent of water, contains:—

* Roberts claims to secure 94 per cent of the juice by adding but 15 per cent of water, and carrying on the first osmotic maceration at 87 to 80 degrees centigrade, and the remainder at a common temperature.

Sugar,	11.580 per cent.
Potassa and soda compounds,	0.441 "
Lime and magnesia,	1.191 "
Nitrogenous substance,	0.791 "
Non-nitrogenous organic substances,	0.983 "

Yield of Sugar.

According to the mode of operation pursued, more or less sugar will be left with the cellular refuse mass. The residue of the hydraulic press contains from 3.6 to 4.8 per cent of sugar, or 0.76 per cent of the amount in the original sugar-beet; while Roberts' mode leaves but 0.1 to 0.2 per cent of sugar. Between these figures lie the quantities of sugar left by the application of other modes of operation. With the removal of the juice begins consequently the loss of sugar, which amounts during the whole operation for its final separation to about 3.5 per cent under a good management of existing methods. To set down losses which occur in a branch of manufacture where peculiar skill so decidedly bears upon the final results, is no doubt quite arbitrary; but it is of interest to notice where they usually occur, and to what degree they affect the final results in many instances. The following statement is presented as a fair one and may serve the purpose just specified:—

One hundred parts of sugar-beet roots, under fair management, are liable to lose sugar as follows:

In the pits by degeneration,	2.00 per cent.
By change into grape sugar,	0.54 "
In process of filtration of the juice,	0.14 "
In defecation and carbonization,	0.21 "
In juice left in the press-cake,	0.76 "
Total loss,	3.65 "

One hundred parts of sugar existing in the beet roots were, in one case, accounted for in the following way at the close of manufacture:—

Crystallized sugar, ...	62.46 per cent.
Sugar left in the molasses, . .	14.75 "
Lost during manufacture, . .	22.79 "
Left in the press-cakes, . . .	11.48 "

Eight per cent of sugar from the beet is at present assumed to be the actual result of most factories with improved modes of operation and superior sets of apparatus; some factories claim even more. The importance of an increase in the yield of crystallized sugar may perhaps be best inferred from a case reported by W. Crookes, F. R. S., in his late publication on beet-sugar manufacture with reference to England. Mr. Baruchson, the beet-sugar manufacturer, is reported as stating that the factory cost £10,845; 150,000 pounds of sugar-beet root has been worked per day for five months; the expenses for labor amounted per year to £5,190; the total expenses per year had been £13,980; the total receipts per year were £20,470; the profits thus had amounted to £6,490, or 24.75 per cent on the first outlay; 6.5 per cent of crystallized sugar had been the result. He further states that one-half per cent of increase of the yield of crystallized sugar would be equal to 7.5 per cent additional profits; eight per cent of crystallized sugar from every 100 pounds of beet roots worked, would thus insure a profit of 48 per cent. Accepting this statement as correct, there is no doubt, but that the English beet-sugar manufacture ought to prosper under their present revenue law. In Germany, where eight per cent of crystallized sugar is obtained, the yield per acre varies from 1,520 to 2,270 pounds of sugar. In France, where but six per cent of sugar is obtained (Walkhoff), the yield is said to be from 1,706 to 2,650 pounds per acre. The same authority states that the average expenses in Germany for the production of sugar per acre, taking the average yield of beet roots as from 23,000 to 24,000 pounds, amount to from $132 to $133, of which the government takes in form of taxes from $45 to $46; while in France, assuming the average yield of beet roots per acre to be from 36,000 to 37,000 pounds, and separating 114.4 pounds of sugar from every 2,200 pounds of beet roots, the whole average expenses per acre for beet-sugar amounts to from $161 to $162, of which the government draws for taxes

on sugar $50.75. The expenses in the two countries are divided among the different operations in the following proportion :—

In Germany :*

Manure,	14.48	per cent.
Cultivation of beets,	11.20	"
Taxes on sugar,	34.82	"
Manufacturing expenses,	39.40	"

In France :

Manure and cultivation of beets,	24.40	per cent.
Taxes on sugar,	31.59	"
Manufacturing expenses,	44.01	"

Taking the produce of an American acre as equal to from 23,000 to 23,500 pounds, and presuming an average percentage of sugar in the beets of from 11 to 12 per cent, allowing at the same time 80 per cent of juice, which contains but 9.6 per cent of the sugar in the beets, and calculating, finally, but 6.5 per cent of crystallized sugar as obtainable from 100 pounds of beets, an American acre would yield 1,500 pounds, which at seven cents per pound† would amount to $105. The molasses obtained from the sugar-beet is not fit for household consumption on account of its unpleasant saline taste. It is fermented in most cases for the production of alcohol, and rarely fed to live stock, as its continued use, even in small quantities, is not considered safe, from its effect on the digestive organs. Its value as food is about one-half that of good hay, and its effect is similar to that of oil-cake. 1.8 pounds of molasses per day mixed with clover hay or even straw has increased the yield of milk. Sometimes the molasses is mixed with caustic lime or the carbonate, and composted for manure.

* Recent reliable private communications coming from different sections of Germany state the expenses for the production of sugar-beet roots, when in the pits, in one case at $46 and in another at $59.50 per acre. Land rent in both cases was equal and amounted to $12.50 per acre; manure in the first case amounted to nearly one-half, in the second case to but one-third of all expenses. The price of labor caused the difference.

† To assume a higher value is unsafe, considering the unsettled views concerning the degree of protection which our sugar industry may claim.

Average Composition of Beet-Sugar Molasses.

Albuminous substances,	9.2	per cent.
Sugar,	41.3	"
Other organic substances,	16.1	"
Saline compounds,	10.8	"
Water,	22.6	"
	100.0	"

The saline constituents of course differ somewhat in every case, particularly as far as the lime compounds are concerned. The following analytical results, (Trommer & Rode), may give some idea about their general character.

One hundred pounds of ash constituents of beet-sugar molasses contain of:—

Potassa,	30.46	per cent.
Soda,	10.12	"
Lime,	26.62	"
Sesqui-oxide of iron,	00.04	"
Carbonic acid,	19.07	"
Sulphuric acid,	1.92	"
Silicic acid,	0.06	"
Chlorine,	10.03	"
	100.00	"

The residual liquid left after the fermentation of the molasses is usually evaporated and the solid mass subsequently calcined. The beet-sugar manufacture furnishes in this form quite a large quantity of valuable saline compounds for general industrial purposes. One hundred pounds of these calcined saline substances contain from 45 to 48 per cent of soluble constituents of a composition more or less corresponding with the following figures:—

Carbonate of potassa,	27.60	per cent.
Carbonate of soda,	4.70	"
Chloride of potassium,	6.75	"
Sulphate of potassa,	6.75	"
	45.80	"

One single beet-sugar factory at Wagehäusel (Germany), sends every year 200,000 pounds of such potassa salts into market, which is mainly used for the manufacture of nitre. The molasses contains by far the largest portion of the soluble saline constituents of the sugar-beets, particularly the potassa compounds which must be returned to the soil directly or indirectly. The cheaper crude sulphate of potassa of Stassfurth is bought at present in exchange for the carbonate of potassa sold.* Distilleries are frequently connected with sugar beet manufactories.

The Cellular Residue of the Beet Root.

The juice is obtained in different ways, and, according to the mode adopted, the quality of the residue is affected. The press-cakes resulting from the application of the hydraulic press, which is the main apparatus employed, are compact in consequence of packing the pulp into bags or coarse linen cloths before subjecting it to the press. 100 pounds of beet roots furnish from 18 to 20 pounds of press-cakes, which consist, in case a very powerful press is used, of:—

Albumen, ...	1.336	per cent.
Potassa, ...	6.487	"
Sugar, ...	4.945	"
Cellulose, ...	11.922	"
Saline matters, ...	1.180	"
Water, ...	74.130	"
	100.000	"

These cakes are highly valued for feeding purposes; 100 pounds of press-cakes are valued at 29.6 cents, when hay is worth 20 dollars per ton; the cellular residue of beets left after the abstraction of the juice by other modes is as a general rule less valuable. For instance, the residue after the treatment with centrifugal apparatus and the subsequent displacement

* The producer of potatoes sells in an average crop of 7.41 acres (three hectares) the mineral constituents of four crops of wheat besides 600 pounds of potassa, and in an average crop of beet roots from the same area the mineral constituents of four wheat crops, besides 1,000 pounds of potassa.—*Leibig.*

process is considered worth but 16.9 cents per 100 pounds; that obtained by hot maceration of dried beet roots is held at from 24 to 25 cents per 100 pounds, while that obtained by a maceration of the fresh beet roots after Roberts' improved method, (free from an excess of lime), is valued at from 7.2 to 9.1 cents per 100 pounds. The last named residue contains but from 5.5 to 6.9 per cent of dry substance, while common press-cakes contain 25 per cent. Roberts' mode of operation leaves about 70 pounds of cellular residuum for every 100 pounds of beet, which contains, as stated previously, more nitrogenous matter in proportion to dry substance, but less sugar than common press-cakes. It is worth as fodder about one-quarter as much, according to the estimate of Grouven.

One and one-half tons of press cakes are assumed in practice as the produce from one Prussian morgen,* or 4,700 pounds per acre, so that allowing a value of 29 cents for every 100 pounds, the whole amount of press-cakes from one acre would be worth $13.60. Moreover, as 100 pounds of common press-cakes contain 25 per cent of dry substance, 4,700 pounds contain 1,175 pounds; and as the dry substance of any article of vegetable food is known to furnish 1.75 times its weight in common stable manure, 2,056 pounds of manure will result from the feeding of the press-cakes of one acre. Reckoning one ton of manure worth $1.75, 2,056 pounds will be worth about $1.80. The fodder value of press-cakes resulting from the operation with the hydraulic press without subsequent maceration is equal to the same weight of sugar-beet roots. They are even preferred to the latter, since they become more digestible and acquire, after being buried in pits in consequence of slow fermentation, a slightly acidulated taste. Cattle then eat them greedily and thrive upon them, particularly in case they are fed in connection with a proper quantity of oil-cake, bran, hay, or barley straw, &c., to replace the potassa compounds and the phosphates which the juice has carried off.

The preservation of the press-cakes is easily accomplished. They are packed closely into the empty beet-root pits or into

* In this report all calculations concerning reductions of German surface measures and of money value are based on the following proportions: one American acre is considered equal to 1.58 Prussian morgen, and one Prussian thaler equal to 0.73 dollars.

brick chambers, being frequently interlaid with a small quantity of chopped straw, and, finally, tightly covered with soil. The fermented mass resulting from this operation keeps in an excellent state of preservation for six to seven months.

Produce of Leaves.

The leaves amount at the time of the harvesting of the roots to about one-fourth of the weight of the latter; calculating as previously, 6,000 pounds of leaves would result from an acre. The leaves are separated upon the fields and subsequently in their green state plowed under deeply, or they are fed either fresh or in a preserved state. The manuring effect of the beet leaves is very great, since they contain in their fresh state more potassa, more phosphoric acid and more nitrogenous substances than an equal weight of roots. Their ash percentage is also larger than that of the beet roots, consisting mainly of alkalies and alkaline earths. Almost one-third of all the potassa, one-half of the phosphoric acid, and two-fifths of the whole amount of nitrogenous substances of the entire sugar-beet crop is contained in the leaves. As they can be fed in small quantity only, in their fresh state, they are salted down in pits. The pits used for this purpose ought to be in a dry locality and dug to a depth of from five to six feet. The bottom is covered from two to three inches thick with a layer of chopped straw of oats, rye or wheat; then a layer from four to five inches thick of fresh beet leaves, mixed with one-quarter of one per cent of common salt is put on and trodden down, and these alternations continued until the pit is not only filled, but raised from two to three feet above the ground, and then a layer of two feet of soil is added as covering. In the same proportion as the mass shrinks in consequence of fermentation new soil is added to keep the covering above the level of the surrounding ground as protection from the rain. The leaves in the pits begin soon to ferment and to discharge moisture, which the straw absorbs; they retain a strong smell until January, when they turn by degrees sweet and are on that account freely eaten by cattle. Sixty pounds of fresh green leaves produce forty pounds of preserved leaf-mass; one acre furnishing thus about 3,900 pounds of such food, which, taking 100 pounds of hay worth one dollar, is valued at 16.3

cents per 100 pounds. One acre would thus produce in food derived from the leaves $6.35; fresh leaves have 11.99 per cent of dry substance, preserved leaves contain 15.0 per cent; the leaves of one acre of sugar-beet root contain therefore 585 pounds of dry substance; which multiplied by 1.75 gives about 1,000 pounds of manure from this source of food. The leaves are never fed by themselves. Grouven recommends the following composition of food for every 1,000 pounds of live weight per day: 40 to 50 pounds of preserved leaf-mass, 40 pounds press-cakes, 3 pounds of rape-cake with 6 pounds of hay. In proposing this composition of food, he presumes that 25 pounds of perfectly dry hay represent the normal qnantity of food required to support 1,000 pounds of live weight per day. A comparison of the mineral constituents contained in 25 pounds of dry hay and 25 pounds of dried sugar-beet leaves explains the proposed practice.

Hay.

Potassa,	0.80 per cent.
Phosphoric acid,	0.20 "
Sulphuric acid,	0.07 "
Chloride of sodium,	0.12 "

Dry Preserved Leaves.

Potassa,	1.00 per cent.
Phosphoric acid,	0.14 "
Sulphuric acid,	0.28 "
Chloride of sodium,	0.52 "

The small quantity of phosphoric acid and the large percentage of sulphuric acid and chloride of sodium in the beet leaves renders their exclusive use objectionable. They are, therefore, fed in common with substances like oat-meal, oil-cake, bran, clover, hay, &c., on account of their richness in phosphates, &c. Preserved beet leaves, it appears from experiments of Tod, increase the production of milk in quality and quantity, whilst press-cakes, if exclusively used, reduce its quantity decidedly. A mixed food of 100 pounds of press-cakes with 75 pounds of preserved leaves produced for every 100 pounds of leaves fed, an increase of 24.5 pounds of milk per day, as compared with

a corresponding feeding of press-cakes alone. The value of press-cakes and preserved leaves for the support of live stock, particularly during a period when food as a general rule becomes scarce and thus expensive, must be quite apparent; especially when we consider further that every ton of sugar-beets raised furnishes 400 pounds of press-cakes and 400 pounds of fresh leaves, and that an ordinary factory consumes from 40 to 50 tons of beet roots per day during five months. In cases where stock feeding is no part of the enterprise, or where plenty of other kinds of food is at hand, the leaves while still green are plowed under. The part which the beet leaves perform in the absorption of mineral constituents from the soil may be seen from the following analytical statement:—

A fair average crop of sugar beets abstracts per acre,—

By Roots and Leaves.

Phosphoric acid,	35	pounds.
Potassa,	164	"
Lime and magnesia,	63.50	"
Silica,	15.09	"

By Roots Alone.

Phosphoric acid,	25	pounds.
Potassa,	126	"
Lime and magnesia,	32	"
Silica,	6.5	"

Returned in form of Leaves.

Phosphoric acid,	10	pounds.
Potassa,	38	"
Lime and magnesia,	31.5	"
Silica,	9.4	"

The General Influence of the Sugar-Beet Cultivation on the Condition of the Soil.

The first question which will be forced upon us in this connection, is: Can the sugar-beet be raised upon the same lands continuously without reducing their value either for the production of sugar beets or for general farm management?

It is no doubt most convenient to refer for an answer to Germany and France, and notice the conditions of the lands engaged in the beet sugar cultivation for generations. We shall find that the yield of good sugar-beets is not diminishing, that the beet sugar industry in fact is continually growing—(has increased in Germany within the last fifteen years threefold)—and instead of reducing the general farm products, in consequence of engaging so large an area in the sugar-beet cultivation, we know from statistical reports that they exceed in value the farm products of previous periods. High farming based on rational principles has taken the lead; to increase the fertility of the soil has been the aim; advantageous systems of rotation have been introduced and the effects of special manures have been subjected to close study. Science has made itself familiar with common farm routine, and an enterprising farming community has listened to its advice. Two facts are quite evident to every intelligent farmer: first, that a certain chemical and physical condition of the soil is required to secure by the crops raised a satisfactory compensation for labor and expenses incurred in its cultivation; and, secondly, that the plants we cultivate differ in their requirements in both directions. The mineral constituents needed for the support of any one kind of plant will be sooner or later exhausted, for nature as a general rule does not change the mineral compounds required for the maintenance of a forced vegetation into a fit state for assimilation so rapidly as most of our farm crops, and the sugar-beet in particular, require. Fortunately for us the disintegrating surface of our globe has been for ages subjected to a leaching process, and its products are daily more and more opened to us in the form of saline deposits of every description; the accumulated results of animal and vegetable life of past generations are brought back to us in the form of guano and phosphates of varying character, while chemistry has taught us how to assist nature in its preparation of plant-food. The physical conditions of the soil, however favorable they may have been, will suffer, if year after year subjected to the same or a similar treatment for the cultivation of one and the same plant; diversity in its mechanical treatment and change of seasons for such treatment cannot otherwise but affect favorably its mechanical condition and its chemical disintegration, promoting thereby its

fitness for the absorption of atmospheric food. The roots of the same plants abstract their food year after year from the same layer of soil; while a change of crop frequently alters the depth from which the food is absorbed. To cultivate the same plant upon the same spot for any length of time is also objectionable on account of the particular chances offered for the growth of those parasites and insects which make that plant their home. These and other reasons demand imperatively a rotation of crops.

The sugar-beet sends its rootlets to a depth of several feet, and draws consequently largely from the subsoil; the latter is on that account, as stated before, of great importance. As the sugar-beet also depends in a high degree on atmospheric food, its leaf growth must be stimulated by a most careful pulverization of the soil, and as the fleshy root needs for its growth a loose, deep soil, deep plowing has been generally introduced. Thorough cultivation and a perfected system of under-drainage being absolutely indispensable to the highest success must necessarily improve the condition of lands devoted to beet culture. Green manuring and a liberal use of stable manure have also been employed to render the soil mellow and rich, and thus the farm lands have reached by degrees a high state of fertility. The use of special commercial fertilizers is resorted to not to the exclusion, but in aid of stable manure, and thus the chemical and physical requirements of the soil are met in the most efficient way. Rotation of crops in connection with a rotation of special manures has demonstrated the practicability of preserving unimpaired the fertility of soil engaged in sugar-beet cultivation.

Without entering here in detail upon this much studied question, I propose to state merely a few observations of a more general interest, in addition to what is said in previous pages. Well manured annual leaf crops for green feeding, are considered the best crop to precede the beet; next in order, follow well manured summer or winter grain crops; less recommended are perennial grasses and other fodder crops; directly objectionable are, if not specially manured, potatoes and root crops in general, of which the mangel is the worst. The sugar-beet, on the other hand, is a good crop to precede almost any other farm plant. The succession of crops adopted in the interest of

sugar-beet industry has reference to two important objects, namely, an adequate supply of food to each crop and the production of the largest possible amount of animal manure. A fair crop of beet roots is of course more exhausting to the soil, as far as phosphoric acid, and particularly potassa, is concerned, than most of our farm plants; a judicious system of rotation divides that effect over several years, and thus enables the farmer to draw more efficiently on the natural resources of the soil, and so avoid a direct outlay of money. The following succession of crops is considered very satisfactory, viz.: green fodder, wheat, sugar-beets, and, finally, a summer grain crop; or barley, sugar-beets, barley, green fodder, wheat, sugar-beets; and these are economical as far as manure is concerned. Two thousand three hundred pounds of hay, or its full equivalent in fodder value, are considered sufficient to replace the constituents which a fair beet sugar crop abstracts per acre in excess of what the refuse material resulting from such crop in the course of beet sugar manufacture will compensate for. The amount of refuse material fit for manuring purposes is counted per acre equal to 4,700 pounds. T. T. Fühling's figures on this question are of great interest as they come from a practical sugar-beet cultivator, whose opinion is regarded as of great importance. They refer to pounds per acre.

	I.*	II.†	III.‡	IV.§	V.‖
Nitrogen,	36.4	19.8	16.6	23.7	32.
Potassa,	96.4	19.	77.4	28.5	33.2
Soda,	39.5	6.3	33.2	9.5	3.2
Lime,	14.2	28.5	33.2	4.	28.5
Magnesia,	9.5	11.9	33.2	4.3	9.5
Chlorine,	28.5	2.4	26.1	4.3	9.5
Sulphuric acid,	7 9	6.4	1.5	11.5	9.5
Phosphoric acid,	15.8	9.5	6.3	2.	4.8
Silicic acid,	17.4	-	6.3	8.	47.4

* Substances abstracted by a full sugar-beet crop.

† Substances returned in the manure obtained from sugar-beets.

‡ Amount of substances not replaced by that manure.

§ Amount of substances abstracted per acre during a four years' rotation as detailed.

‖ Amount of substances restored to the soil by the manure resulting from the feeding of 2,300 pounds of hay.

Comparing these analytical results, we find that the manure obtained from the beet roots and from the hay replace what, in the course of a few years' rotation, as specified above, will be taken per year from one acre. Wherever a farmer deviates from the practice previously stated, potassa and phosphoric acid must be largely supplied in form of special manures, as superphosphate of lime, or flour of bones and wood-ash, or crude sulphate of potassa. One hundred acres of good meadow-land in twelve hundred acres under cultivation for beet-sugar manufacture are considered in Germany a suitable proportion to raise the amount of hay required.

Stock feeding then becomes a prominent feature in the farm industry. The farm produce is largely sold in the form of live weight, and the manure is more cheaply produced by fattening live stock than it can be bought. The farmer keeps only as many horses as are indispensable, and does his farmwork, as far as possible, with oxen. He looks upon cows, if not favorably located for the milk-market, as a mere manure-machine, and keeps only as many as required to make up the stock wanting. Sheep-fattening, if he has suitable pasture, he considers a profitable business. In feeding his stock he believes in the efficiency of feeding high, to reduce the expenses of keeping; and this produces also the cheapest manure. Every animal requires a certain amount of food for daily support independent of its increase in weight; the shorter the time for fattening the more food for mere keeping is saved. In calculating the quantity of food required for the various kinds of stock, the following figures are frequently adopted: for every one hundred pounds of live weight, 3.33 pounds of hay or its equivalent per day are considered necessary as the mere support of farm stock in cases of ordinary employment, and five pounds of hay or its equivalent for every hundred pounds of live weight for fattening purposes. In the case of young stock, eight times as much food is given for production of weight as for mere sustenance; from every hundred pounds of food for support, and fifty pounds of food for growth, from four to six pounds of increase in live weight are expected as return.

Summing up the value of the various products of one acre of sugar-beets, we find at a very low calculation the following result:—

Sugar, 1,500 pounds at seven cents,	$105 00
Molasses,	2 90
Press-cakes,	13 60
Preserved leaf-mass,	6 30
Manure (about two tons),	3 50

(Profit, in converted produce, &c., &c.)

Every cent of increase in the price of the sugar would be equal to fifteen dollars additional profit per acre, and every one-half per cent increase in crystallized sugar from every hundred pounds of beet roots worked, would add about 115 pounds of sugar to yield, or $8.05 additional profit per acre. These additions in profit are by no means beyond reach, for the best management in Europe realizes them.

To enter, in concluding this Report, upon a detailed calculation of what our expenses for the production of the above articles per acre would be, could be at best but a mere approximation.

It may suffice to keep in mind that in Europe from forty-six to fifty dollars per acre has to be paid in taxes to the government; that our lands are cheaper, and that machinery is taking daily more and more the place of the hand in planting seeds, in cleaning the fields, and in securing the juice from the beet roots. Where the final pecuniary results may differ so widely, as must be quite apparent from previous statements, in consequence of a more or less favorable location of the factory and the skill engaged in its management, it is unsafe to state a definite sum of profit. It must here, as in every similar instance of an industrial enterprise, suffice to know that money can be made if the business be intelligently managed. As far as the farmer is concerned there is little risk. While the profits of the beet-sugar manufacturer may be lessened by changes in provisions of political economy, the farmer is not necessarily subjected to influences of that kind. In this case, he is aware that root crops are profitable, and that aside from this, his farm lands will receive a treatment which has everywhere been proved to enrich, rather than to exhaust the soil.

To restore his land to something like its original productive-

ness, and to do this mainly through capital furnished by outside parties, is worthy his serious consideration.

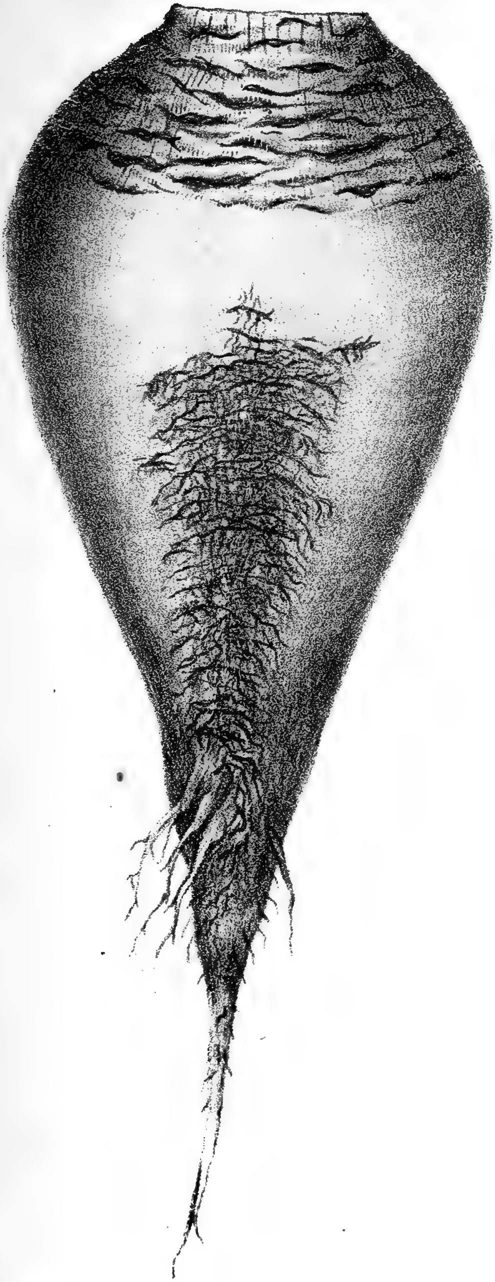
The real importance of this subject to the farming interest of the Commonwealth, as well as to the people at large, can never be satisfactorily determined, except by a series of wisely conducted experiments, which can no where be so appropriately undertaken as at the Massachusetts Agricultural College.

APPENDIX.

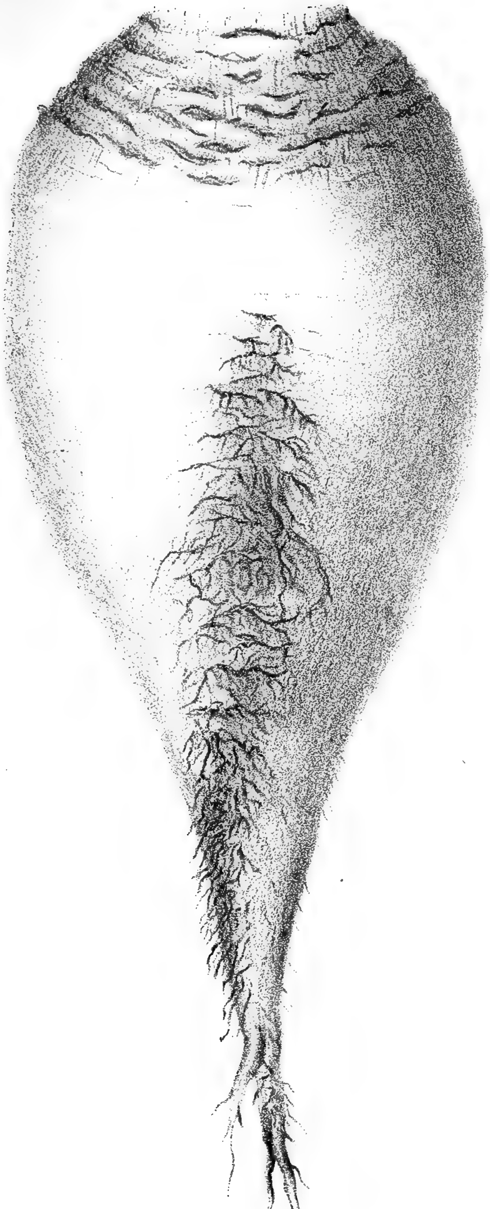
Results of the Examination of Sugar-beets raised on the College Farm during the past season.

NAME.	Source of Seed.	Weight, in pounds.	Percentage of Sugar in juice.
I.—Vilmorin beet, . . .	Saxony, .	$\frac{3}{4}$ to $\frac{7}{8}$	15.50
II.—Vilmorin beet, . . .	" .	$\frac{3}{4}$ to 1	15.61
I.—White Imperial, . .	" .	$\frac{3}{4}$ to $1\frac{3}{4}$	14.20
New Imperial, . . .	" .	$1\frac{1}{4}$ to $1\frac{3}{4}$	13.80
I.—White Magdeburg, . .	" .	$1\frac{1}{2}$ to 2	13.10
Quedlinburg, . . .	" .	$1\frac{1}{2}$ to $1\frac{3}{4}$	13.44
II.—White Imperial, . .	" .	$1\frac{3}{4}$ to 2	10.27
II.—White Magdeburg, . .	Silesia, .	$1\frac{1}{2}$ to $1\frac{3}{4}$	10.06
White Silesian, . . .	" .	$1\frac{1}{4}$ to $1\frac{1}{2}$	9.72
III.—Vilmorin beet, . . .	" .	$1\frac{1}{4}$ to 1	9.93
Long White beet, . .	" .	$1\frac{1}{4}$ to $1\frac{3}{4}$	8 60
White Sugar beet, . .	" .	$1\frac{3}{4}$ to 2	7.20
Vienna Red beet, . .	" .	$1\frac{3}{4}$ to 2	8.10

The percentage of sugar was ascertained by means of a polarization apparatus, and the results obtained, in several instances, verified by Trommer's test. My thanks are due to Mr. J. E. Heyl, of Philadelphia, for kind assistance rendered in the laboratory work during his stay as special student in chemistry at the Agricultural College.

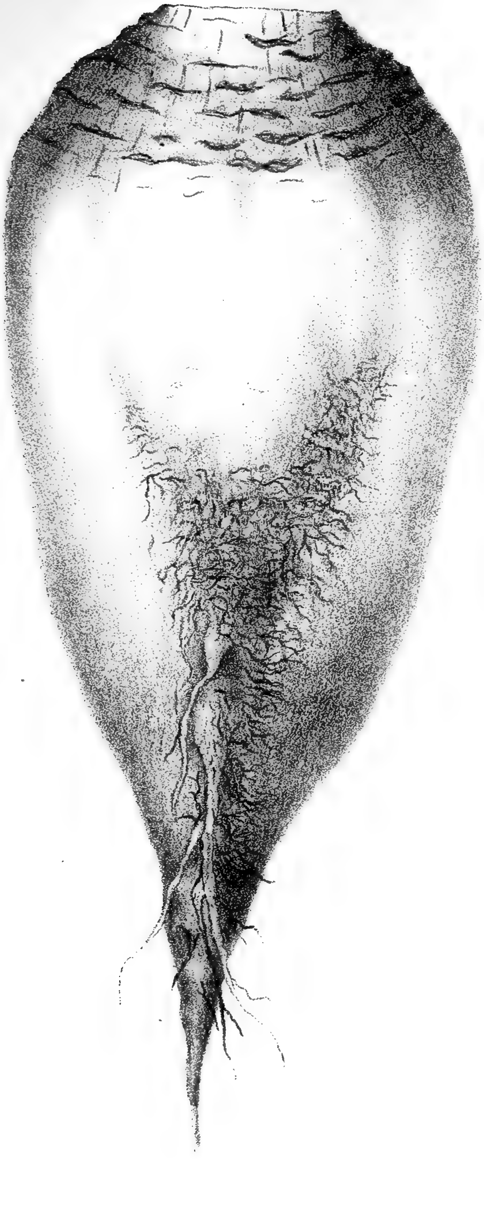


FRENCH VILMORIN SUGAR BEET
Weight 1 lb.



FRENCH VILMORIN SUGAR BEET.

Weight 1 lb. 4 oz.



WHITE IMPERIAL SUGAR BEET.

Weight 1 lb 1 oz.

BEST SILESIAN SUGAR BEET

Weight 1 lb 5 oz

REPORT

OF THE

EXAMINING COMMITTEE OF THE OVERSEERS.

11

REPORT.

The undersigned, appointed by this Board, a Committee for the visitation and examination of the Agricultural College for the year 1870, do report as follows :—

Two of the Committee, Messrs. Goodman and Stone, have visited the college at the end of each term, and have given close attention to the examinations, and have also examined in detail the results of the operations on the farm, and all other matters of importance connected with the institution, while Professor Agassiz, owing to sickness, has only visited Amherst incidentally during the summer. The examinations of the students in classes have been upon agriculture, horticulture, botany, physiology, chemistry, geology, mental and kindred sciences; and we have witnessed the military drills, and observed with gratification the topographical drawings by the students. Having had a previous knowledge of many of the young men, we are convinced that the system of instruction is well calculated for the ends in view, and that the students are making commendable progress in their studies, and that the several professors are not only accomplished in their respective departments, but earnest and thorough in the prosecution of their duties.

The leading object, of course, in this institution, in compliance with the Act of Congress, to which it owes part of its endowment, is to teach such branches of learning as are related to agriculture, and to include military tactics, and it seems to us, that the course of study and instruction laid down is eminently in consonance with that object, and that the sciences taught are with pointed reference to the uses of the farm.

The theory of scientific agriculture is thoroughly taught, and the application of such knowledge is made on the farm under the direction of the professor in that department, who is a practical farmer; and all students are compelled to work at the details of husbandry, so that manual labor becomes a valuable adjunct to mental application. Chemistry, botany, physiology and zoölogy are, of course, invaluable to the farmer in regard to the analysis of soils, the use of manures, the food of animals, the growth of grains and fruits, the anatomy and physiology of animals, and the conditions and habits of destructive insects; and mathematics and civil engineering, in the use of the chain, compass and level, are almost equally necessary. Specialties, such as logic, mental and moral philosophy, political economy, English literature and modern languages, must also to some extent be embraced within the curriculum of any educational institution of a high order. Without entering at all into the discussion as to the value of classical learning in an ordinary course of education, and without intending to cast a doubt upon the utility of such studies to develop the mind and heart, exalt the aspirations and improve the taste, it is enough to say that they are not absolutely necessary in agricultural colleges, and that during the period (none too long) in which the students are passing through the course as laid out, there is none too much time devoted to the more special studies appertaining to the direct object of the institution.

As the Act of Congress especially includes military tactics as a leading branch to be taught in all colleges receiving the bounty of the nation, and without expense to the State, and details an accomplished officer to instruct the classes in such tactics, it may appear supererogatory to say more upon the subject; but your Committee cannot refrain from alluding to the interest which all the young men take in the drills, the evident beneficial effect upon their bearing and health, and the value of the accomplished soldiers and officers thus made for the future service of the Commonwealth, in the event of another call to send forth her sons for herself or the nation. Were no other result accomplished by this institution the money of the Commonwealth could be no more judiciously expended, and yet this instruction is but an incident to the regular course.

The two members of your Committee who have visited the college have, as before stated, given special attention to the farm, both on account of the criticisms current regarding it, and because to one of said Committee, at least, the farm is the major part of the premises. At our first visit last winter certain parts of the barn adjuncts were in admired disorder, owing to the violence of the gales in the fall and the inundation of the cellar. For the latter reason the manure could not be properly composted, nor were the cattle above so arranged and bedded as seemed right in the eyes of the more advanced farmers; but under the personal direction of the farm superintendent, who brings to his work, not only muscle, but intelligence of a high order, the proper remedies were applied to these disorders, and, with the exception of a restoration of the cattle-sheds in the yard, to rebuild which there are no funds, everything about those premises is in good keeping, and the excellence of the crops, taken from the fields in which this imperfectly composted manure was mingled, attests a careful culture. And it must not be forgotten that this was the first season in which the whole force of the farm, especially the teams, could be applied to its development, the appropriations by the legislature of money to erect buildings having been always made at the beginning of the farming season. And your Committee in this connection desire to correct what they regard as a popular error, viz., that the college should possess a model farm, like a Dutch garden, complete and formal in every part. On the contrary, we think it should be a working farm, on which all experiments may be tried, and if necessary, over and over again, that the students may take part in all kinds of agricultural labor; but, of course, a main object should be to grow profitable crops, and to plant, cultivate and harvest them in the best manner and condition. It is desirable, also, that more attention should be given to the garden, and the students be early taught the value of so important a part of the farm, and we trust that out of the first appropriations of money for the college, a sufficient sum may be applied to the erection of suitable forcing beds for the production of early vegetables, by which, not only can the pupils be instructed in one of the most profitable branches of agriculture, but no inconsiderable revenue could be derived from the sale of the products in the vicinity of the college.

The farm is now well stocked with cattle, a large proportion of which are thoroughbreds, and though purchased at reasonable rates fairly represent the various breeds. They are stabled and bedded comfortably, and the manure made by their means and the matter composted with it will enable such enriching to be given to the soil, that the farm products must necessarily, under proper cultivation, yield hereafter largely in excess of previous seasons. In addition, a valuable young stock will soon be growing up, and the cattle of the vicinity, and through it that of the State, will be continually improved by the use of the bulls, whose services are afforded at such reasonable rates as to give no excuse for the least prosperous farmer to degrade his stock by breeding to inferior ones. These pure-bred animals were put in competition with many others of the same class at one of the large exhibitions in the State the past fall, at which one of your Committee was present, and received a due share of admiration and premiums.

From what we could learn from the students who take their meals at the boarding-house we infer that they consider the board as good as can be afforded for the moderate price charged, and if we should suggest any alterations as to details it would be to reduce the amount of meat and add more largely vegetables and farinaceous food, and especially unbolted wheat bread, and, in lieu of pastry, substitute fruits of the season. But under the present system the person who hires the boarding-house, and is limited as to the price which he shall charge the students who board with him, cannot be expected to do more than give a fair equivalent for such price; and probably as the products of the farm increase, the trustees who have the oversight of this matter and are not blind to its importance will contrive some plan by which the students may have a greater variety at the minimum price. But as long as the energetic president of the college has any old apple-trees on the farm to be cut down or any other active employment for the young men, there will not be much complaint from them about their food, if it is abundant and of good quality. It must not, however, be forgotten that the only mode of providing board for such students as are unable to pay but a small price is by some such regulations as are now enforced on the person keeping the house, and that it is optional with other students whether they board there or elsewhere.

We commend to the consideration of the trustees the suggestions of the Committee of last year as to the boarding-house being run under their directions, and have no doubt they will come to a conclusion in consonance with the best interests of the students and the college.

"No man," said Jefferson, "ever repented of having eaten too little." Students will hardly subscribe to this axiom; but they do not desire, nor should they have, during their life at college, aught but plain, wholesome fare, similar to what they had at home. Upon a review of our examination of the college and the farm, we are satisfied that great improvements have been and are being made in all the departments, that the students are not only well taught the theory of the various sciences in the class-rooms, but are practically instructed in the laboratory, in the field, the garden and the drill-room. The future usefulness of the pupils in agriculture is also held up prominently to their eyes, and the kindred sciences taught are necessary adjuncts to its full development, and no more special attention is bestowed upon them than is necessary for such purpose.

It is too late to re-open the question as to the necessity of educating the farming community for its own sake as well as for the sake of all other classes. To the rural population we must look for the substratum of all society, and from it come not only those who provide the material means for the subsistence of all others, but from its ranks are recruited the greater proportion of the most reliable business and professional men, and useful and efficient women. This class of society should be able to furnish the best possible material in the future, as it has in the past, for the use of the State, but as its prosperity has not increased in the same proportion as that of others it cannot care for itself, even as formerly, when the pinchings of parental economy, the savings of fraternal and sisterly affection, scarce sufficed to educate one member of the family; and now that education in other institutions has become so costly, farmers' sons can only be instructed in institutions adapted to their means and objects.

Whether or no special institutions can educate agriculturists, and whether the business of farming can be conducted

scientifically, and to the profit of the farmer and the nation, are questions of the past. The hundreds of agricultural schools in Europe attest the avidity with which more thorough knowledge—of the natural laws which govern the growth of crops and the atmospheric changes, of the habits, anatomy and diseases of domestic animals, of the principles of mechanics applicable to farm implements and machinery, and of many other things, not possible to be learned without special instruction—is sought; and the result of such instruction has been shown by the greatly increased production of the soil in those countries which foster these institutions.

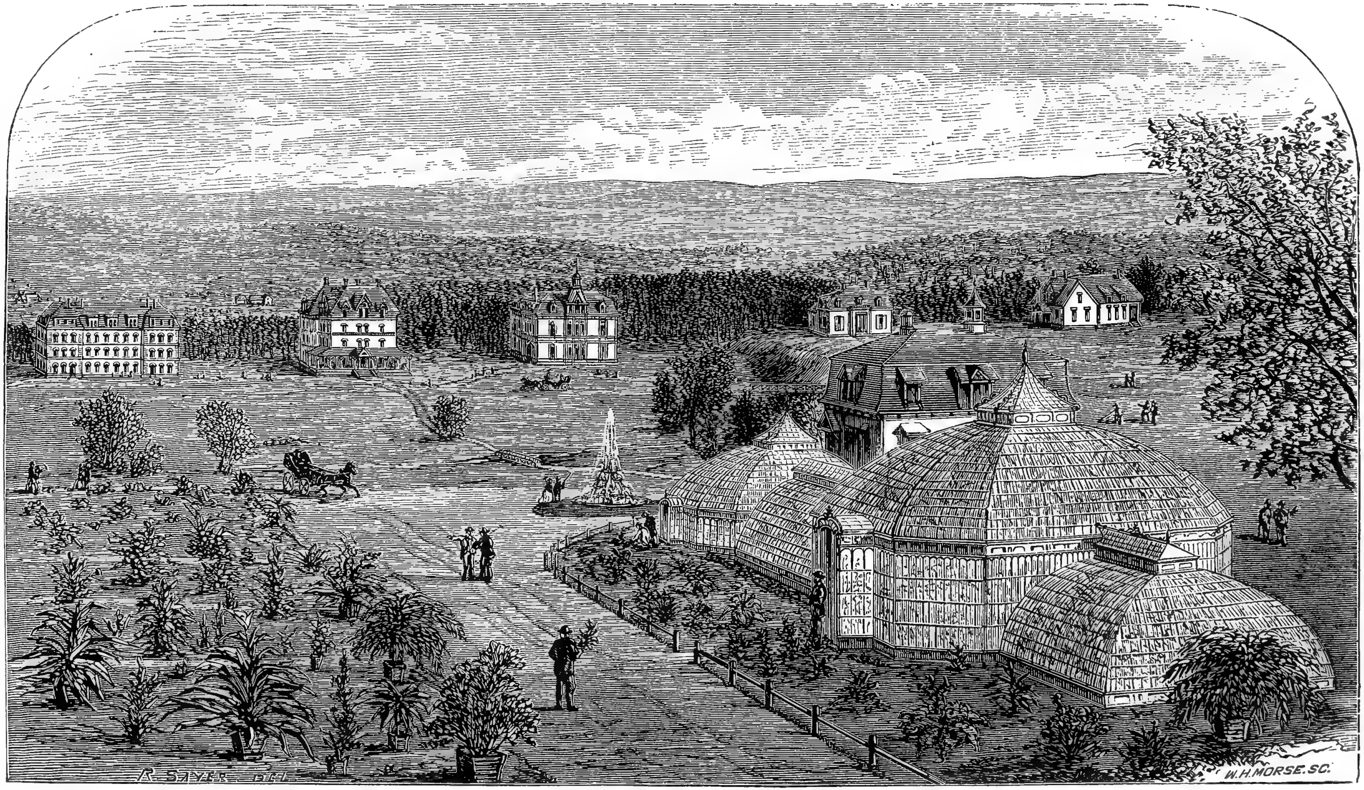
With the aid of a national grant, the State of Massachusetts has initiated an institution to promote the education of the most prominent and numerous industrial class in the Commonwealth, and so far as the experiment has progressed it is a success. It is not, however, complete, for the original scheme of providing buildings for four classes has not been perfected, and until that is done it cannot be said that the spirit of the original grant nor the intentions of the organizers of the institution have been carried out; and, if the experiment should by any possibility now fail, it would be owing, not to any lack of applications from the class whose instruction is had in view, nor from any want of energy or ability on the part of the trustees, presidents or teachers of the college, but solely from a want of accommodations for the tendered pupils. No educated and interested observer of this institution can fail to note that a four-years' course is barely sufficient to perfect the students in the necessary learning for the objects in view; and that, if sufficient accommodations are afforded, the college will be filled by large classes, while, as the number of pupils increases, the expenses of the institution will be met by a corresponding increase of resources.

We hope to see this institution put upon a complete and solid footing. At present, since it has no wealthy alumni to appeal to, and the people for whose sons its instruction is intended are, in the main, of very moderate means, its only reliance is, in the outset of its career, upon the beneficence of the whole community represented in the legislature, and we do not believe that community will desire that an experiment which has been so far successful shall now fail for need of that support which,

if not expressly promised, was impliedly vouched for at its inception.

At the proper time, we trust a professorship of veterinary science will be added to the college, and the diseases and treatment of the horse and other domestic animals be so taught that we shall have a class of men among us qualified to treat the ills of those animals in a scientific and humane manner, and the present system of quackery and inhumanity be abolished.

LOUIS AGASSIZ.
RICHARD GOODMAN.
ELIPHALET STONE.



MASSACHUSETTS AGRICULTURAL COLLEGE.

SENATE...... ....No. 100.

NINTH ANNUAL REPORT

OF THE

TRUSTEES

OF THE

Massachusetts Agricultural College.

JANUARY, 1872.

BOSTON:
WRIGHT & POTTER, STATE PRINTERS,
79 MILK STREET (CORNER OF FEDERAL).
1872.

INDEX.

Commonwealth of Massachusetts.

EXECUTIVE DEPARTMENT, BOSTON, February 12, 1872.

To the Honorable Senate and House of Representatives:

I have the honor to transmit herewith for the information of the General Court, and such disposition as may seem advisable, the ninth annual report of the Trustees of the Massachusetts Agricultural College, with accompanying documents.

W. B. WASHBURN.

Commonwealth of Massachusetts.

AMHERST, February 7, 1872.

To His Excellency WILLIAM B. WASHBURN.

SIR:—I have the honor herewith to transmit to "the Governor and Council," in accordance with the requirement of chapter 378 of the General Laws of 1871, the ninth annual report of the Trustees of the Massachusetts Agricultural College.

Very respectfully, your obedient servant,

W. S. CLARK, *President.*

ANNUAL REPORT.

To His Excellency the Governor and the Honorable Council:

The Trustees of the Massachusetts Agricultural College respectfully present the following Report for the year 1871.

A beneficent Providence has bestowed extraordinary prosperity upon the College during the past twelve months. Its property has been largely increased, its facilities for instruction multiplied, its faculty strengthened by the addition of able men, its students more numerous and faithful than ever before, and, while it has received much commendation at home, its unqualified success has acquired for it a favorable reputation throughout the entire country.

These results are largely due to the kind offices of His Excellency Governor Claflin, who has uniformly exerted his influence in favor of the institution. The following extract from his message to the legislature of 1871 evinces a hearty and intelligent appreciation of its object, plan, and requirements:—

"The Agricultural College has steadily grown in importance and in the confidence of the public. The number of students already admitted and the number presenting themselves for admission, each year, show clearly that there was a demand for such an institution in the community. An impartial examination of the curriculum of studies must convince any candid man that it is eminently calculated to meet the practical wants of the present time. This college affords an opportunity for any young man to study the natural sciences, and fit himself, at the same time, by daily observation and labor for the pursuit of agriculture. It gives him a thorough course of instruction in English literature; he is obliged to study military tactics and to practise them daily, so that, when he is graduated, he is well qualified for military duty and command. So far as the

classes have gone on, they show good proficiency, and it is confidently expected by the friends of the institution that the class, which is to be graduated this year, will compare favorably with classes in our other colleges in the studies which they have pursued. The expenses of the course in this college are not large, and it is the aim of the trustees to bring them within the reach of any young man of enterprise and energy who desires to obtain an education which will fit him for the active labors of life. The practical value of the College will be more apparent hereafter, and its friends firmly believe that the day is not far distant when a large number of students will be in attendance, and that it deserves and should receive the fostering care of the State. Give it means to educate three hundred students, and it is expected that it will be of no further expense to the Commonwealth, but become self-sustaining, and that then, like other colleges, needed improvements will be furnished by the beneficence of the wealthy, aided by the strong support of the alumni who will be graduated from year to year."

By a resolve of the legislature of 1870, the secretary of the board of education and the secretary of the board of agriculture were directed to devise a plan, if practicable, by which the College might, without expense to the Commonwealth, be recognized as an independent institution in analogy with other colleges in the Commonwealth, and to inquire whether the term of study in said College should not be reduced; and report to the next general court. The obvious intent of this inquiry was to limit, if possible, the growth of the College, and to prevent the full development of the plan which had been unanimously adopted by the trustees, with the approval of the governor and council. The thanks of all the friends of agricultural education are due to Hon. Joseph White, the efficient secretary of the board of education, for the earnest and able investigation which he gave this subject, and for his valuable report to the last legislature (House—No. 420), in which he was cordially seconded by Secretary Flint. After a thorough review of all previous legislation, the conclusion is reached that the State has assumed the following obligations:—

"*First.* To establish an institution with such needful equipment of lands, buildings, books, apparatus, and teachers, as shall enable it to furnish the education, both in kind and degree, which the act

of Congress and the idea conveyed in the term 'Agricultural College' imply.

"*Second.* To furnish to the institution thus endowed, either by annual grants or by permanent endowment, sufficient means in addition to the congressional fund for its continued existence in a healthful, working condition.

"Until these obligations are reasonably and fairly discharged, it is not 'practicable' to sever the connection between the College and the Commonwealth, and withhold from it further aid, in consistency with that character for good faith which it has ever been the pride and glory of her people to maintain.

"The act of Congress already quoted declares the 'leading object to be, without excluding other scientific and classical studies, to teach such branches of learning as are related to agriculture and the mechanic arts, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life.' These are noble words, worthy of the legislators of a great and free people. Their meaning is clear and need not be mistaken. They propose to elevate labor from the dust and drudgery of unintelligent toil to that higher condition which intelligence creates. They would add to the practical training which is essential to success in the several industries of the country, that broad and liberal culture which will raise them to the rank of 'professions in life.' They would aid in training the young men to become not simply skilled artisans and tillers of the soil, but also the intelligent members of a free state, competent to form and give free expression to just opinions relating to the rights and duties of citizenship.

"It seems, therefore, plain to us that with any considerable reduction the prescribed course of a study would fall far short of that liberal culture which this act contemplates.

"Moreover, it will not be denied that the Agricultural College should hold an equal rank with the other technical schools which have shared in the bounty of the Commonwealth, whose courses of study cover a period of four years, and are fully equal to that of the College in respect to the scientific and general culture which they afford.

"Another consideration which has great weight with the trustees arises from the necessity of adapting the terms of admission to the average attainments of the young men desiring to enter the College, when they should reach the proper age to be admitted. Living as they do in the country, and for the most part enjoying only the advantages of the common schools, it was at once seen that the terms of admission must be such as can be met by boys of sixteen

or seventeen years of age who have made good use of such school privileges as are within their reach, and that the higher terms for admission which the other colleges prescribe would exclude from this the larger number of those for whose benefit it was established. A course of four years, therefore, becomes a practical necessity, in order that the student may complete with tolerable success the scientific and practical education which it is the special design of the College to give.

"The recommendations of the report are: *First.* That the sum of $50,000 be granted to the trustees of the Agricultural College, to be expended in the erection of an additional building, and in otherwise completing its establishment.

"*Second.* That the sum of $150,000 be added to the fund derived from the congressional grant, entitled 'The Fund for the promotion of Education in Agriculture and the Mechanic Arts,' the income thereof to be appropriated according to existing law.

"*Third.* That the act incorporating the Agricultural College, with the amendments thereto, be so altered and amended as to give the trustees the power to fill the vacancies which may occur in their number, but retaining therein those who represent the Commonwealth as *ex officio* members, and also retaining the board of agriculture as a board of overseers, with such powers as they now possess."

Through the judicious and zealous efforts of Hon. Richard Goodman, Calvin R. Taft, Esq., and other friends of the College, the following laws were enacted by the last legislature:—

RESOLVES in relation to the Massachusetts Agricultural College.

Resolved, That the sum of fifty thousand dollars be allowed and paid out of the treasury to the Massachusetts Agricultural College, to be expended by the trustees for the payment of all existing debts of the College, and all current expenses of the same not otherwise provided for, and the residue to be applied toward the erection of necessary buildings.

Resolved, That there be paid from the treasury into the perpetual fund, created by virtue of the provisions of chapter one hundred and sixty-six of the acts of the year eighteen hundred and sixty-three, and entitled "The Fund for the promotion of Education in Agriculture and the Mechanic Arts," a sum sufficient to increase said fund so that it shall amount in the whole to three hundred and fifty thousand dollars, the income whereof shall be paid as provided by existing laws. [*Approved May* 26, 1871.

AN ACT to amend the Act incorporating the Massachusetts Agricultural College.

Be it enacted, &c., as follows:

SECT. 1. Chapter two hundred and twenty of the acts of the year eighteen hundred and sixty-three, entitled "An Act to incorporate the Trustees of the Massachusetts Agricultural College," is hereby amended, to wit:

Strike from the first section thereof the words, "whenever vacancies shall occur in the board of trustees, the legislature shall fill the same," and substitute therefor the words, "also from time to time to elect new members."

Strike the last sentence from the fifth section and substitute therefor the following: "The College shall furnish to the governor and council a copy of the annual report of its operations."

SECT. 2. This act shall take effect upon its passage. [*Approved May* 26, 1871.

GRADUATION DAY.

The closing exercises of the college year occurred July 17, 18 and 19, and were of an exceedingly interesting character. Among the numerous distinguished visitors of the occasion may be enumerated the following, viz.: His Excellency Governor Claflin, with several members of his Council and Staff, Hon. Justin S. Morrill of Vermont, Hon. Marshall P. Wilder, Dr. George B. Loring, Professor Agassiz, President P. A. Chadbourne, Hon. Joseph White, Hon. Charles L. Flint, and the majority of the board of Trustees and Overseers. The people of Amherst and vicinity also entered with enthusiasm into the festivities of this first graduation anniversary, and manifested their interest not only by attending the exercises, but also by a brilliant illumination of the village and the avenue leading to the College. Gentlemen from abroad were very much impressed by this hearty good-will of the citizens towards the institution here founded by the State for the practical education of the people.

Besides the examinations of the several classes, which occurred on Monday and Tuesday, the principal events of the occasion were as follows: On Monday evening, the prize declamations were delivered by members of the three lower classes. On Tuesday afternoon, class-day exercises were held, and, in the evening, an address was given before the literary societies by Dr. George B. Loring, which was an eloquent review of the

advantages resulting from the numerous applications of science to the affairs of common life, accompanied by a vivid picture of the improvements to be expected in the agricultural community from the thorough education of farmers. After the address, a reception given by Governor Claflin was attended by several hundred persons, who were addressed by Senator Morrill, and entertained by a torchlight parade of the college cadets, the music of the Springfield Armory band, a brilliant display of fireworks, an illumination of the college buildings, and a midnight salute of artillery. On Wednesday morning, the college cadets were reviewed by the Governor, in the presence of many spectators, on the college campus. The public speaking by members of the graduating class occurred in the village, and was listened to by a large and appreciative audience, who were evidently surprised by the high degree of culture and manly self-reliance exhibited by the speakers.

Professor Agassiz was upon the platform, and, having been introduced to the audience as one who had been a devoted friend of the College from the beginning, said,—

"He had been very solicitous in regard to the success of this experiment in agricultural education, but after what he had seen, he was entirely satisfied. Infinitely more had been done than could have been expected. The farmer might now be an educated man, the equal of the scholar and the philosopher. There need no longer be any difference between the education of the city and the country. He was particularly gratified by the methods of imparting knowledge adopted by the faculty, and was glad to see the dull routine of the recitation from text-books substituted by the fresh, practical instructions of the living teacher. He was sure all present would agree with him in pronouncing the College a complete success."

After the valedictory address by James Henry Morse, of Salem, His Excellency Governer Claflin, president of the board of trustees, delivered an instructive address to the members of the graduating class, concluding as follows:—

"I congratulate you on the success of your efforts to secure an education which will enable you to meet the responsibilities of life with high honor. With the concurrence of your instructors,

the trustees, and especially these visiting friends, among them Professor Agassiz, whose love of science is only equalled by his love of humanity, and who is chiefly interested in the success of this institution because he believes it a new instrument for the elevation of man, I may now assure the people of the Commonwealth that their highest expectations have been fully realized, and that they can take a just pride in an institution established by their authority and sustained by their munificent appropriations. Being the first graduates, much will be expected of you, not in the brilliancy of your performances, but in the faithfulness with which you serve the public in such occupations as you may follow.

"The friends of the College have every confidence in its future, but you can greatly add to their number, and increase its influence, by maintaining an unswerving integrity and unselfish devotion to duty.

"These degrees are conferred upon you with the cordial approbation of the authorities of the College, for they feel that you have faithfully followed their instructions.

"The friends of the College congratulate you upon the success which has attended your efforts, and you have the best wishes of the people of this great Commonwealth, whose noble purpose in founding this institution you will more highly appreciate as you mingle in the affairs of men, and as you have a clearer perception of the great purposes of life.

"As you leave these pleasant scenes to commence your selected work, resolve to be true to the instructions given you here, to the great principles of liberty, and to the guidance of Holy Writ."

The president of the faculty then conferred the degree of bachelor of science upon the twenty-seven young men who had satisfactorily completed the four years' course. The diploma and seal of the College have been very handsomely designed and engraved by Messrs. Gavit & Co., of Albany, N. Y. The vignette of the former represents the State coat of arms, with a rising sun in the background. On the right, is Ceres, the goddess of agriculture, seated in the midst of sheaves of wheat and other appropriate emblems, and, in the distance, a pleasant farm-house, a ploughman in the field, and a glimpse of ships on the ocean. On the left, is Minerva, the goddess of learning and of war, with scientific apparatus and military devices, and in the distance, the tented field.

The seal is circular, and has a diameter of two inches. In

the center is the shield of the United States, surrounded by flowers and fruits, and surmounted by the spread eagle, and around these the inscription, "Massachusetts Agricultural College, Amherst, 1863."

The diploma bears the following words: "The Massachusetts Agricultural College, in accordance with the recommendation of its Faculty, and by authority of the Commonwealth, hereby confers upon ——— the degree of BACHELOR OF SCIENCE, in consideration of his having completed the prescribed course of study and training," and the signatures of the governor of the State and the president of the College, with the seal of the corporation.

The closing exercise of this memorable anniversary was an historical address by Hon. Marshall P. Wilder, senior member of the board of trustees, who has been more closely identified with efforts for the promotion of agricultural and horticultural improvement than any other American. The address was able and interesting, and has been published by the College as a valuable contribution to the history of agricultural education. The following extract will suffice to show the sentiments of this noble man towards the institution and the cause for which he has perhaps done more than any other person:—

"And here I desire for myself, and in behalf of those with whom I have been associated, to acknowledge the goodness of that Divine Providence which has prolonged our lives, and permitted us to witness the establishment of an Agricultural College in Massachusetts.

"It is not often that the projectors of like enterprises are permitted to reap the harvest of their sowing. Soon, all of those who twenty years ago were banded together for the promotion of agricultural education in this State, will have gone to their reward; but I esteem it as among the choicest reminiscences of my life, that I have enjoyed the friendship of those wise and good men. I have climbed the summit of the hill of life, and am descending on the other side. Ere long I shall reach the valley below, and be buried in the bosom of my mother earth; but while I live I shall labor with such ability as I possess, to promote the welfare of this College, and the good cause which we have so long had at heart. May this institution live on, prospering and to prosper. May it rise yet higher in the scale of popular favor and usefulness, sharing the good-will of the people, the munificence of noble-hearted men and the fostering care of a generous government."

College Regatta.

Under ordinary circumstances, it might seem trivial to allude in an official report to the boating interests of an agricultural college, but when the chosen champions of our oldest and largest university are signally defeated by half a dozen farmer boys who have enjoyed very limited opportunities for training; and when these farmers not on'y pull right away from all their competitors in the regatta, but actually row three miles quicker than any other college crew ever has, it may not be improper to make a note of it. At all events, the victory was one of great importance to the winners, and presented the Massachusetts Agricultural College before the public in a very favorable light. Multitudes in Boston and vicinity, as well as in all parts of the country, then for the first time became thoroughly aware of the existence and merit of the institution: and the beautiful prize banner with the words, "College Regatta" on one side, and "University" on the other, which now adorns its museum, will serve to show future generations the vigor of its early youth. The first regatta of the Rowing Association of American Colleges occurred on the Connecticut, at Ingleside near Springfield, July 21st, 1871, and was witnessed by several thousand interested spectators. The race was three miles straight away, and won in sixteen minutes and forty-six and a half seconds by the college crew, consisting of the following students, to wit: George Leonard, captain, Arthur D. Norcross, Henry B. Simpson, Gideon H. Allen, Fred. M. Somers and Fred. C. Eldred, stroke.

Farming, at least in youth, is evidently favorable to the development of both brain and muscle, and the Agricultural College course, with its manual labor, its military drill and its out-door exercise in engineering, botany and other branches of natural history, as well as its quiet yet industrious student life, manifestly tends to impart that robust strength, self-reliant courage and general intelligence which will enable its graduates to win success in the world.

Faculty and Students.

The most important changes in the corps of instructors have been in the departments of military tactics, mathematics and veterinary science.

Capt. Henry E. Alvord, who has discharged the duties of military professor during the past two years with marked acceptance, has been compelled by circumstances beyond his control to resign his commission in the army.

Prof. Selim H. Peabody, of Chicago, Ill., has entered upon the business of his office, as the successor of the lamented Professor Miller, with energy and popularity. He has had much experience in teaching, and is well known in the West as an author of good repute. He is a graduate of the University of Vermont, and will undoubtedly prove a most efficient and acceptable member of the resident faculty.

Prof. Henry James Clark, of Lexington, Ky., has accepted the chair of veterinary science, and will teach zoölogy, human and comparative anatomy and physiology, the principles of breeding domestic animals, and their proper treatment in health and disease. Professor Clark has enjoyed the advantages of study at Harvard College, Harvard Medical School, Cambridge Museum of Comparative Zoölogy, and in Europe. He has been adjunct professor of zoölogy at Harvard, and professor in the Agricultural College of Pennsylvania, and in the University of Kentucky. His reputation as a microscopist and an original investigator in the sciences to which he has devoted himself is of the highest order, and as he proposes now to build up an anatomical museum, and apply his scientific attainments to the establishment of a veterinary department, we may confidently expect in this connection results creditable and useful both to the College and the Commonwealth.

The theoretical and practical instruction in agriculture has been given by Professor Stockbridge, and has been quite satisfactory to all parties.

Professor Goodell has delivered a valuable course of lectures on English literature, and by his enthusiastic and well directed efforts has awakened much desire in the classes under his charge for literary improvement.

In the chemical department, everything has been managed by Professor Goessmann with great economy, and yet with excellent results. The instruction has been interesting and profitable, and a great number of important questions, relating especially to commercial fertilizers and the sugar beet, have been subjected to the test of experiment. The report of the learned

professor on the quality and value for sugar making of the beets raised upon the college farm the past season, which is herewith submitted, sufficiently attests both his industry and ability.

Professor Parker has had charge of the moral and religious instruction of the college, and the special training of the senior class in mental philosophy and original declamation. If the general good behavior of the students and the appearance of the graduating class at the last anniversary be taken as specimens of his work, he may well be considered a successful teacher.

Courses of lectures have been given upon particular topics during the year past by the following non-resident lecturers, viz.: Hon. Marshall P. Wilder, Hon. Joseph White, Dr. George B. Emerson, Dr. George B. Loring, Hon. Charles G. Davis, Dr. S. J. Parker, Alonzo Bradley, Esq., Prof. E. S. Snell, Prof. Edward Hitchcock, M. F. Dickinson, Jr., Esq., and Prof. Richard H. Mather. Many of these lectures were exceedingly valuable, and yet none of the gentlemen named received more than a mere nominal sum for their services, several refused all compensation beyond their traveling expenses, and some declined even this.

The number of students in 1871 has been one hundred and sixty-six, or many more than in any previous year. The larger part of them are from Massachusetts, but there are representatives from twelve other States of the Union as well as from Spain and Japan. Every county in the Commonwealth is represented except Nantucket. There has been no hazing of freshmen, and no collision between classes, and very little, if any, wanton destruction of public property. The students as a body are quite remarkable for their industry, fidelity, economy and gentlemanly conduct.

Pioneer Scholarship of 1871.

The class which graduated July 19th, at their parting supper, voted to establish a perpetual scholarship amounting to $72 per annum, to be called the "Pioneer Scholarship of 1871," and to be awarded to that student of the freshman class who should comply with the following conditions, to wit: "The successful competitor must maintain a rank in scholarship above ninety; his deportment mark must be one hundred, and he must have

no unexcused absences. If no one attains so high a standard, the faculty are to select the one who comes the nearest to it. The student to whom the award is made must not receive any other scholarship, but shall retain this for four years, provided he keeps his high standing to the satisfaction of the faculty."

It is an interesting fact that there are now in the freshman class three competitors for this prize who rank 95, 96, and $98\frac{3}{5}$, whose deportment is perfect, and who have no unexcused absences. The award is to be made at the end of the freshman year.

Horticultural Department.

The Durfee plant house is now in charge of Mr. Willard C. Ware, a graduate of the College, and its contents are in good condition. The building has been thoroughly repaired and painted, and is well stocked with about one thousand species and varieties of plants. Among them may be found many of special interest to the student of botany, and others of economical importance in tropical countries, as well as all such as are commonly cultivated under glass for ornament. The most valuable addition recently made to this department is a collection of sixty-seven species of rare trees and shrubs, raised in the public garden at Washington, D. C., and presented to the College by William Saunders, Esq., the accomplished superintendent.

Among the interesting fruits which have ripened in the plant house during the past year may be enumerated those of the orange, the lemon, the guava, the fig, the pineapple, the granadilla, the banana, the seaside grape, the prickly pear, the coffee, the tea, the sago cycas and many others.

A large number of fruit, flowering, and forest trees and shrubs have been raised in the nursery either from seed or by budding, and several hundred of suitable size have been transplanted to form hedges and orchards, or for ornament and shade. A portion of the ground designed for an arboretum has been planted with potatoes and partially prepared for its intended use. The vineyard has been well cared for and will doubtless produce a large quantity of grapes the coming season.

About one hundred species of fodder plants were grown in contiguous patches under the direction of Mr. S. T. Maynard, of the senior class, and specimens collected for the Knowlton

herbarium. The same gentleman has also made several hundred drawings to illustrate systematic botany, and prepared in a very superior manner models of more than one hundred varieties of fruit, choice specimens of which were kindly sent by Mr. Saunders from Washington, by Colonel Wilder from Boston, and by Messrs. Ellwanger and Barry from Rochester, N. Y.

There is a great need of money for the further development of this department.

The plant house should be completed according to the original design to give more room for the general collection and especially for the trees, several of which are already too large for the present building. There is also urgent want of glass structures for propagating purposes, for growing early vegetables, and especially for warm and cold graperies and orchard houses. Until these are furnished, it will be impossible to give the students suitable instruction in horticulture, and prepare them to take charge of the gardens and plant houses of wealthy persons who would be glad to employ them, after graduation, at good wages. The last-named improvements would cost but a few thousand dollars, and would give a large return of income from the sale of the plants, flowers, fruits, and vegetables produced. A wise expenditure in this direction would render this department self-supporting and relieve the treasury from a heavy annual draft.

It is also hoped that some wealthy friend of the College will soon generously provide the fund of $50,000 necessary to the proper maintenance of the botanic garden and aboretum. Much has been already accomplished in the preliminary work of preparing plans, and in underdraining and otherwise fitting the ground, which is admirably suited to the object in view. If such a fund could be obtained for the horticultural department, and a similar one for the agricultural, many valuable results would follow. The College would thus be developed in the right direction and rendered obviously peculiar among our educational institutions; indigent students could be provided with remunerative employment, and experiments of the utmost value to the Commonwealth might be constantly carried forward under the most favorable conditions for success.

The College Farm.

The agricultural operations of the year have been well managed by Superintendent John C. Dillon, whose annual report herewith submitted contains a statement of what has been undertaken and accomplished in this most important department of the College. While with larger expenditures more satisfactory results might have been attained, it will still be evident to any candid observer that great improvements have been made in several directions. The conveniences for the care of neat stock, sheep, swine and poultry have been largely increased at a cost of nearly $5,000. The thoroughbred animals have been multiplied by natural increase, by purchase and by gift, until there may now be seen under one roof excellent representatives of seven imported breeds of cattle. The general appearance of the estate has been improved by the removal of most of the worthless apple-trees, unsightly stumps, hedge rows and boulders which had not in former years disappeared under the vigorous assaults of successive classes of freshmen. The roads and walks have been graveled anew and kept in fine order. The cultivated fields have been well cleaned of weeds and yielded remunerative crops. Some ditches have been opened, but less tile laid than in former years, in consequence of the large amount of labor required in laying one thousand feet of aqueduct pipe, and in grading during the autumn months.

The great difficulty in the way of the most successful management of the college farm is the want of active capital, which is the one chief hinderance to really profitable agriculture throughout the Commonwealth. Prof. George H. Cook, of the New Jersey Agricultural College, who has recently made a tour of observation in Europe, asserts that the active capital of a farmer should equal the value of his farm. Nothing in English agriculture more surprises an American than the extraordinary expenditures of money which are everywhere indulged in, even by tenant farmers, in the management of lands.

This is well illustrated in the case of Mr. James Campbell, of Buscot Park in Berkshire, England, who undertook an experiment in the cultivation of the sugar beet the past season. Knowing that root crops delight in a deep and mellow soil, he plowed 1,600 acres for his beet field, and with a subsoil plow

stirred it thoroughly to the depth of three feet. Well understanding that coal was cheaper than grain, and steam power therefore cheaper than horse power, he began his preparations for business by the purchase of four steam-plows of thirty-horse power each. These cost him more than $30,000, but they pulverized his land to the depth of a yard at the rate of four acres per hour, the total expense being fifty cents per acre. He then harrowed it by steam, using harrows with teeth twelve inches in length, and so fitted his land for beets. Then fully assured that he should have a crop, he expended more than $100,000 for buildings and machinery to manufacture it on his own premises, and is now said to be feeding the refuse to 2,500 neat cattle and 12,000 sheep.

The farmers of Great Britain now use 3,000 steam-plows, costing about $7,500 each, and probably spend more money for commercial fertilizers, deep culture, thorough drainage and irrigation, every year, than ever has been expended for these purposes in the Commonwealth of Massachusetts. It is evident, therefore, that much money must be constantly employed in the wise management of the college farm. The $75,000 already expended for land, buildings, stock, implements and improvements, have merely served to prepare the way for active operations. These cannot be profitably carried on without a liberal use of capital, and the annual receipts for produce sold must be very small so long as the annual appropriations are on the same scale.

The numerous economical applications of steam in agriculture render it very desirable that the College should be provided with steam machinery for plowing and harrowing, for threshing and grinding grain, for cutting fuel, lumber and fodder, and for cooking roots and steaming food for stock. Such mechanical operations would not only furnish useful and instructive employment to many indigent students, but would also serve to awaken an interest in the whole subject of steam on the farm in the minds of all who should visit the College. Besides doing the work at home, a steam-plow would find abundant occupation on the unfenced and level diluvial plains and alluvial meadows of the adjoining towns. It would be exceedingly interesting to see what effects could be produced upon the clayey hardpan, which underlies a large portion of the land in

Amherst, by means of a powerful steam-engine, and it is earnestly to be hoped the experiment may be tried at no distant day on the college estate. It can hardly be doubted that if the generally shallow soil of Massachusetts could by judicious subsoiling and plowing be gradually increased in depth, it would not only produce much larger crops in favorable seasons, but would be enabled to withstand much better than at present the disastrous droughts which so often blast the hopes of the farmer. While there are many portions of the State which are too hilly or rocky for the steam-plow, there are many others, including all the best tillage lands, where there are no serious obstacles, except the multitude of fences and the small size of the farms. The sooner a large part of the old fences are used for fuel the better, and the number of enclosures actually needed, even with our present style of farming, is much less than commonly supposed. The coöperative system in regard to agricultural machinery, which has been adopted by the farmers of Framingham, might be applied profitably to the use of steam-plows. In England, some landlords now furnish a steam-plow for the use of their tenants, and charge for plowing a sufficient price per acre to meet the running expenses, the cost of repairs and the interest on the first outlay. A plow costing $7,500, will easily turn over, to any desired depth, thirty acres per day of ordinary soil, and will do the work quicker, better and much cheaper than is possible by any other means.

At a recent trial of steam machinery for farm use under the auspices of the Royal Agricultural Society of England, there were no less than ten competitors, and the first prize for plows was taken by Messrs. Fowler & Co., who have been manufacturing for fifteen years the Fowler steam-plow. With a machine of twenty-horse power they plowed four acres in an hour to the depth of fifteen inches.

Will not some one of the wealthy gentlemen who are spending money so freely in importing stock, erecting expensive barns, or beautifying old farms at great cost, purchase for experimental use at the College, one set of the most approved steam machinery for plowing, harrowing, rolling, ditching, clearing fields of stumps, stones, etc., in order that we may have an opportunity to learn what advantages are to be derived from the employment of the best now made, and that Yankee

ingenuity may have a chance to study and remedy whatever is defective?

Beet Sugar.

The cultivation of the sugar beet for the manufacture of sugar, has been made the subject of much experiment and study at the College during the past year. One hundred pounds of recently imported seed of the best French and German varieties were obtained from the Beet Sugar Company in Sauk County, Wisconsin, early in the season. Five acres were cultivated on the college farm, and seed distributed to various localities in the State, with the view of testing the adaptation of the crop to our soil and climate. The cost of cultivation under favorable circumstances could not be determined, from the total want of suitable machinery, which it is designed to import from Germany for use the coming season. The results which have been attained by Professor Goessmann and his assistants with great difficulty from the lack of suitable apparatus, are exceedingly gratifying and perfectly conclusive, so far as the practicability of an economical production of sugar in Massachusetts is concerned. The beets grown were of good shape, with a very firm flesh, and the juice obtained was rich in saccharine matter, and free from any excess of injurious substances. Sugar was manufactured in every form desirable, such as white coffee, granulated and loaf, of the finest quality. Samples of the brown sugar sent to refiners in Boston and New York were pronounced of superior grade, worth from eight to nine cents per pound. With skillful cultivation and manufacture there would be little difficulty in obtaining one ton of sugar per acre on the better class of tillage lands in Massachusetts. 30,000 acres would supply each of her inhabitants with forty pounds per annum. There are cultivated in the State 60,000 acres of corn, and the total value of the crop averages only forty dollars per acre. Would it not be better to spend the $5,000,000 or $6,000,000 now sent to Cuba for sugar in producing our supply at home? We should thus furnish employment to more laborers in summer, and create a new branch of manufacturing industry which would afford pleasant and profitable work in winter. Sugar is a delicious and most desirable article of food, the demand for which increases in proportion to the advancement of nations in wealth and civili-

zation. In the year 1700, only 10,000 tons were used in Great Britain, but in 1870, the importation of sugar amounted to 600,000 tons. The consumption of sugar in the United States was fifteen per cent. greater in 1871 than in 1870, and amounted in the aggregate to 700,000 tons, for which the people paid more than $100,000,000 in gold, besides the profits of refiners and dealers. To this enormous amount of sweetening, which is vastly more than was used in any other country, must be added 150,000 hogsheads of molasses and sorghum syrup consumed during the past year. We require, therefore, for our present supply nearly one-fourth of all the sugar produced in the world, and with our rate of increase in wealth and population, shall need from ten to twenty per cent. per annum more as the years roll on. The sugar of the American people costs them more than their bread, and while it can in all probability be raised in any of the Northern States with as much certainty and more profit than corn, they are buying it for gold of foreigners. In view of these facts, true patriotism, as well as a wise public policy, demands the introduction of the sugar-beet culture into the Commonwealth at the earliest practicable moment. There is nothing in the history of agriculture so wonderful as the uniform and rapid development of the beet-sugar industry during the past twenty years on the continent of Europe. The production in France has risen from 60,000 tons to 300,000; in Austria, from 10,000 to 80,000 tons; in Russia, from nothing to more than 100,000 tons,—so that to-day the people of that northern country consume three times as much sugar as they did in 1850, and produce it all from their own soil.

The two principal arguments of those intelligent persons who doubt the feasibility of introducing this business into Massachusetts with profit, are based upon the relatively high price of our labor. But in Europe the internal revenue tax equals almost the cost of the sugar. England taxes beet sugar grown on her own soil at the same rate with her colonial sugars, while in France and Germany the tax is between three and four cents per pound, or from forty to fifty dollars per acre on the beets. Here the national government levies an impost of from two and one-half to three and one-half cents per pound on foreign sugars, and admits sugar machinery free of duty, while there

is no internal revenue tax whatever. Will not these advantages more than compensate for the difference in the wages of workmen?

Another class of persons who lack faith in the beet-sugar industry, are those who know that nearly all our sugar is the product of the sugar-cane, cultivated and manufactured by slave labor, and that sugar planting has been exceedingly profitable in Cuba and other tropical islands. Their argument is, that the beet cannot compete successfully with the cane as a sugar-producing plant, because the latter under favorable circumstances, will yield two or three times as much sugar to the acre. Some, admitting that with the present tariff sugar might be profitably grown in Massachusetts, still object that as soon as Cuba or San Domingo are annexed and their sugars enter our markets free of duty, beet sugar will fail to be a profitable crop.

But it should be remembered that sugar planting has never greatly prospered except with slave labor, and whenever sugar from the West Indies is free to enter our ports on account of annexation, the negro will be free to labor or not as he pleases. With the privilege of importing slaves from Africa and driving them to their unrequited toil with the whip, the planters of Jamaica exported 150,000 hogsheads of sugar annually, but, notwithstanding indemnity for emancipation, and favorable legislation on the part of England, the annual product has declined with free labor to 30,000 hogsheads. The work of the cane-field and the sugar-mill is severe, and in time of harvest admits of no intermission, day or night, and the ignorant negro of the plantations can never be induced to labor with regularity and energy by the mere stimulus of wages amid the luxuriant vegetation of the tropics. The public sentiment of Christian nations is now so utterly opposed to both slavery and the coolie system, that they must soon be abolished, and then it cannot be doubted that the beet, in a temperate climate, where it is both necessary and honorable to labor, will furnish sugar more economically than the cane. In fact, beet sugar already demands its place in the great markets of the world, as some speculators have recently found to their damage, for its increased production in Europe has prevented any such rise in prices as would otherwise have occurred in consequence of the

war in Cuba. During 1871, nearly 100,000 tons of beet sugar were imported into England, paying tax where produced, and duty when landed, and then successfully competing with sugar from the cane, cultivated in some cases by free, and in others by slave labor. It is evident, therefore, that we shall soon begin the use of sugar from the beet, whether we will raise it or not, since the supply of this indispensable article of food from the tropics is not at all likely to keep pace with the rapidly increasing consumption, and Europe will be able and willing to furnish any amount we want.

The sugar beet seems to have been specially designed to encourage a rational system of agriculture, which should not only produce remunerative crops, but at the same time increase the fertility of the soil. No useful plant adapts itself more readily to a variety of circumstances, and no one has fewer destructive enemies. There is no crop, however, which responds more readily to good treatment, as is seen in the fact that, during the past season, one cultivator in Belgium is reported to have obtained roots at the rate of eighty-two tons per acre by manuring with linseed oil applied to the extent of one hundred dollars' worth per acre; while another, in France, boasts of eighty-five tons per acre, the roots, transplanted from a rich seed bed, attaining a weight of between thirty and forty pounds each.

In order to produce a large percentage of sugar, the roots must be grown in a deep, mellow, well tilled and thoroughly drained soil. This is obviously best for all crops, but most of the staple articles cultivated in Massachusetts are surface plants and will yield a fair return on soil only six inches deep, if it be well manured. This thin stratum, therefore, is generally the only one ever disturbed, and the fertilizing elements below remain useless. But the beet seeks its mineral constituents from the lower layers of the soil, sending down its rootlets many feet, where the character of the land and the tillage permit. Thus the valuable salts from the subsoil are pumped to the surface, and passing into the foliage of the plant stimulate it to digest the carbonic acid and water which it converts into cellulose, starch and sugar.

Another very important consideration respecting the beet crop is seen in the utilization of it. The sugar which is sold contains no valuable mineral constituents whatever, but con

sists of carbon and water only, and, therefore, deprives the farm of nothing.

The leaves, which are rich in salts, and vary in quantity from five to ten tons per acre, are left on the field for manure, or may be fed to cattle. The trimmings and refuse from which the juice has been extracted are most excellent food for stock of all kinds, and may be preserved for winter use with but little trouble. Hence the beet grower is able to keep many cattle, which furnish meat, milk and manure, and thus insure the means for improving the soil. It is a well established fact that those districts in Europe which produce the most beets are also the ones which yield the greatest product of bread and meat, and are in all respects the most prosperous.

The alluvial meadows of the valley of the Connecticut are remarkably suited to the sugar beet, and it will be surprising if their wealthy owners do not enter heartily into its cultivation. The most feasible plan for a successful experiment would seem to be somewhat as follows: Let a company be organized with a capital of $100,000 for the erection of a factory capable of manufacturing at least fifty tons of roots per day, and let the farmers contract to deliver at the factory, every autumn for five years, the beets raised on a certain quantity of good land, properly tilled. The company might perhaps obtain exemption from taxation for ten years, and then pay six dollars per ton for washed and trimmed roots, besides returning to the producer gratis all the refuse. The farmers ought to furnish at least 10,000 tons of roots annually, and at the above price would be sure of a handsome remuneration for their crop.

Conclusion.

The year 1871 must ever be memorable in the history of the College. Then for the first time the governor of the Commonwealth in his annual message highly complimented the institution, and recommended it to the favorable consideration of the legislature. The committee of investigation, appointed by the legislature of 1870 for the avowed object of limiting its course of instruction, and thus its annual expenses, reported in favor of the existing plan and a larger endowment. The legislature of 1871, after printing 10,000 extra copies of the annual report, and carefully inquiring into the condition of the College, voted

with remarkable unanimity an appropriation of $50,000 for its immediate wants, and $100,000 for the increase of its permanent fund. Those who had been predicting failure, and harshly criticising the efforts of its friends, now suddenly ceased their opposition and admitted, at least tacitly, that an agricultural college might successfully accomplish the object of its establishment. The Pioneer class on graduation day surprised most of those who attended the exercises, by the style and substance of their speeches, as well as by their large number and manly appearance. The address of Col. Wilder, and the affair at Ingleside, are worthy a place in the annals of the year; and the natural result of all these favoring circumstances was the filling of every r om with excellent students at the beginning of the collegiate year.

The College is now in good condition to educate one hundred young men, which is all that its dormitories can properly accommodate. The State has most wisely and generously granted the large sum of $430,000, which has been increased from other sources to $530,000 for the founding of an institution to promote the interests of agriculture. Yet there is urgent need of a public building for a chapel, library and museum, which should be the finest edifice on the grounds, and cost not less than $50,000. There should also be erected, as soon as possible, two large dormitory buildings similar to those now in use, which would furnish rooms for one hundred more students. These would require about $30,000 each for their construction.

Though many liberal persons seem to hesitate about giving their money to a State institution, because, as they reason, the State is able to appropriate whatever sums may be really demanded by the circumstances of the case, yet it does seem to be the duty of the friends of education and progress to show some appreciation of what has been so nobly done by the government. During the past year, Miss Mary Robinson of Medfield has died, and left a bequest of $2,000, to establish a scholarship, and several others have given smaller sums. Why should not wealthy persons bestow their riches to erect buildings, endow scholarships, prizes and professorships, or create a labor fund in the College which is especially designed to give to the people at a moderate cost a practical education? Massachusetts has laid a magnificent foundation, and pledged herself

to preserve it forever. Where can the benevolent and public-spirited citizen place his property to greater advantage for the promotion of education, than in the care of a board of trustees who, while enjoying the liberal patronage of the Commonwealth, are still a self-perpetuating corporation beyond the reach of political changes?

Respectfully submitted,

By order of the Trustees,

WM. S. CLARK, *President.*

AMHERST, Jan. 1st, 1872.

REPORT

ON

SUGAR BEETS RAISED UPON THE COLLEGE FARM.

By Prof. CHARLES A. GOESSMANN, Ph. D.

REPORT.

In a previous report, I expressed the opinion that the profitable cultivation of the sugar beet for the manufacture of sugar in Massachusetts, must depend, if not exclusively, at least essentially, on the interest intelligent agriculturists will take, first, in a careful selection of superior seeds of the best foreign varieties, and subsequently of the choicest seed beets; and secondly, in the proper choice of lands which are not only well adapted to the cultivation of root crops in general, but also in such a state of fertility as to enable the farmer to supply the kind and amount of plant-food required for the production of a special crop for a special purpose. Considering these premises of first importance, I attempted a short exposition of the ways and the means by which these requirements have been accomplished elsewhere, showing how farmers and manufacturers by a mutual understanding have contrived to promote their mutual interest, and that their great success was particularly due to the fact that the farmer in his legitimate attempts to produce a large crop never failed to keep in mind that the ultimate object was to secure a sugar beet which would contain the desired amount of sugar under advantageous conditions for its separation. He knew that the manufacturer would value every percentage of sugar at about 2.4 cents with more or less of the vegetable refuse of roots, and the leaves returned. The history of the pioneers of the beet-sugar industry in every country, ours not excepted, furnishes striking illustrations of this truth. German beet-sugar manufacturers do not hesitate to ascribe their great success over other competitors at the World's Exhibition at Paris, in 1867, to their superior sugar beets.*

To transfer a known process of manufacture from one country to another is a simple problem, and offers, in skilled hands,

* In Germany, the beet-root is taxed; in France, the beet sugar produced; which is a sufficient reason to account for the superiority of German skill and machinery.

but little risk in cases where the materials to be turned to account can be shown to be either identical or to stand at least in some fixed relations to those which have been previously used. Quite different, however, are the circumstances when the introduction of an industry like the beet-sugar manufacture is contemplated; for a good sugar beet is the result of the particular influence of peculiar modes of farming, of soil, and of climate. To suspect a possible serious change in the composition of a sugar-producing plant like the sugar beet in consequence of a transfer of its seed from one country and soil to another is but reasonable, in view of our past experience concerning sugar-cane,* sorghum,† the cultivated grapes, and fruits of every description. The sugar planters of Louisiana and of the West Indies have to accommodate their modes of operation for the manufacture of sugar to suit the peculiar variety of cane they are cultivating. Even upon the island of Cuba, planters cannot manage the details of their operations alike, and expect to be equally successful. As the system of manuring, the kind of soil, and the quality and depth of the subsoil in particular, besides certain conditions of the climate, are known to exert a powerful influence on the quality, and thus the fitness of the sugar beet for the manufacture of sugar; and as all these controlling influences vary more or less in different countries, it is quite plain that a series of well-designed and carefully conducted experiments are desirable for the purpose of studying the behavior of a good imported sugar-beet seed upon our soil and under our climate. They are indispensable as a reliable basis for the introduction of the beet-sugar manufacture as a home industry. Animated by these considerations and somewhat encouraged by the results of the preceding year, my examinations in the field and in the laboratory have been continued and enlarged upon during the past season. The results, which have been gratifying in both directions, will be described in the following pages. I confined myself, for obvious reasons, to the following points. First, to produce good sugar beets in sufficient quantities and in accordance with the rules recom-

* See "Notes on the Manufacture of Sugar in the Island of Cuba," by C. A. Goessmann, Syracuse, N. Y., 1865.

† On Sorghum, or Chinese Sugar Cane, by C. A. Goessmann, see the Transactions of the New York State Agricultural Society of 1860.

mended in my report for 1871; secondly, to study the chemical properties of the sugar beets raised on the college farm with reference to their fitness for beet-sugar manufacture; thirdly, to ascertain by actual tests the amount of sugar available for commercial purposes.

I. On the Cultivation of the Sugar Beet.

The field selected for the cultivation of the sugar beets consisted of four and seven-tenths acres which slope gently to the west; the soil was a warm, sandy loam, with the exception of the south-west corner, which, being wet, was subsequently planted with common mangolds. Grass had been raised upon the land for many years, until the fall of 1869, when it was ploughed and the surface covered with a good coat of coarse yard manure. In the spring of 1870, it was planted with corn, each hill receiving a handful of phosphate, and yielded 70 bushels of corn per acre. It was thus, in consequence of a suitable selection of manure and a satisfactory preceding crop, in a desirable condition for the production of sugar beets. During the spring of 1871, it was ploughed three times, harrowed and rolled to make its mechanical condition as favorable as possible. The entire field was subsequently divided into five equal parts, running from east to west, conforming with its slope. Each of these divisions received, a few days before seeding down, five hundred pounds of various commercial phosphates, which were sown broadcast. The various kinds of seeds, which were imported during the last two years, had been previously tested in regard to their fitness for germination, and they all produced, after some soaking in water, healthy young plants within from seven to ten days. The following varieties and respective quantities were planted by means of Holbrook's seed drill, the most suitable implement at hand.

Of Vilmorin of 1869,	1.5	pounds.
Imperial of 1869,	7	"
Imperial of 1870,	11	"
Electoral of 1870,	10	"
Vienna Globe of 1869,	1.3	"
Varieties of Mangold of 1870,	1	"

The rows were about two and one-half feet apart and passed from north to south through each one of the various fertilizers. The planting of the seed took place on the 11th and 12th of May, and on the 22d of May most of the rows were distinctly marked by the young crop. The entire field looked well, with the exception of the first few rows on the east side, where some trouble with the seed drill had left empty spaces. These spots were subsequently filled out with young plants taken from other parts of the field at the time when the surplus plants were cut out. After thinning, the plants stood from six to eight inches apart. During the time from the first of June to the 21st of July, the young plants were three times hoed to keep the root tops covered, and the space between the rows cultivated as many times with a horse hoe to destroy the weeds. The entire crop looked promising at any time during the entire season, with the exception of the transplanted beets, which remained behind in spite of an additional manuring, and confirmed the statement made in my previous report that the general experience of beet-sugar cultivators teaches that it does not pay in most cases to transplant; for these plants remain usually so far behind that they are of no value for sugar manufacture. Towards the end of September, the outer leaves began to dry up, indicating, under normal circumstances, the ripeness of the roots. My examination concerning the saccharine properties of the various kinds of beet roots began at this time. The harvesting of the entire root crop took place on the 19th and 20th of October. The danger of a severe frost rendered it advisable to protect the roots against its damaging influence. They were for that reason buried without delay after being freed from the leaves, care being taken not to bruise them. The pits were six by three feet, and three feet deep, and located on the upper side of the beet field. The leaves had already somewhat suffered from the frost, and were mostly dried up. The larger portion of them were on that account left upon the field to serve as manure. A small quantity of leaves still green were however collected and buried in a pit twelve feet long, three feet wide, and three feet deep, to be kept till spring for experimental purposes. The root crop averaged per acre 22,200 pounds. This amount exceeds the product in Silesia, and ranks with the usual crops in Saxony. The results obtained

upon the experimental field of the college farm may be looked upon as gratifying and encouraging, particularly when we remember the reduction caused in the crop by the defective operation of the seed-drill, and also keep in mind that the entire operation of planting it had to be managed with unsuitable implements. The rows of beets, instead of being twenty inches apart with eight inches space between the plants, which would have secured from 28,500 to 30,000 plants per acre, had to be kept two and one-half feet apart to allow the horse and cultivator on hand to pass between the rows, causing a great waste of land. There are implements long used in the sugar-beet cultivation which locate the rows from eighteen to twenty inches apart, and which are used both in seeding and in cultivating from four to eight rows at once. In view of this first actual yield, I believe that with suitable implements our annual produce of sugar-beet roots per acre would rank with the highest yield in Saxony, which is stated to be from 30,000 to 32,000 pounds per acre. In my original plan for the fertilization of the beet field, I designed to apply from 250 to 300 pounds of Stassfurt potash fertilizer per acre. The scarcity of these valuable potash compounds in our markets when wanted, prevented their arrival at a sufficiently early date. Although a small strip ten feet wide in each of the five main divisions of the field received, finally, some commercial kainite at the rate previously mentioned, no particular importance will be attached to that fact. The sugar beet is manifestly a potash plant, and the application of potash fertilizers but rational. Their good effect cannot be doubted wherever the soil has been shown to be really deficient in available potash compounds, and where time and the peculiar physical condition of the various layers of the soil have favored their penetration to the strata upon which the plant under cultivation mainly feeds. Neglect of these important points may be looked upon as the cause of existing contradictory statements. To apply the Stassfurt fertilizers to meadow grasses, or even potatoes, as a surface dressing, or shortly before their planting, may give satisfaction in most cases; for these plants live, comparatively speaking, largely upon the surface soil, and their roots branch in every direction in search of food. The sugar beet, on the other hand, sends by natural disposition its main roots to the subsoil, the quality

of which is therefore of great importance. The potash must descend to the subsoil, as exact investigations of a more recent date demonstrate, before its beneficial effect* will be noticed on plants like the sugar beet. This circumstance explains to some extent at least the peculiar fact, that potatoes and sugar beets, although preëminently potash plants, have been raised alternately upon the same lands for years in succession, with satisfactory results,† without showing the usual signs of exhaustion which such a practice in most instances would soon produce. In connection with the investigation of the previous questions, an interesting fact has been noticed which deserves attention, particularly as it may lead to misconstructions. It was demonstrated by careful experiment (Frank) that a small percentage of the chloride of sodium aids in the circulation of the potassa compounds in the soil, it acting in that respect similarly to the nitrate of soda, and apparently counteracting the ordinary retentiveness of the soil, and favoring the passage of the potassa to the subsoil. The chloride of potassium and the sulphate of potassa are alike readily decomposed in a good soil. The potassa is always very eagerly retained in the surface portion of a soil of good physical condition, and passes only gradually to lower depths, provided the soil has not received an unusually large supply, and is not too inferior in retentive quality. It takes usually months before its surplus will reach the lower strata, and the rate of its downward motion depends in ordinary cases entirely on the chemical and physical condition of the soil. Chlorine and the mineral acids, with the exception of phosphoric acid, differ essentially in that respect and pass on more rapidly to the drainage waters. The demand for chlorine is limited, not more than 0.08 per cent. of the amount introduced by the application of chloride of potassium being absorbed by sugar-beet roots. The absence or the presence of chlorides in mineral fertilizers affects the root crop but slightly, provided a sufficient amount of potash is supplied, and the chloride of sodium not used in excessive quantity. Whenever potash is wanting, and at the same time common

* 250 pounds each of kainite and of superphosphate per acre are highly recommended.

† Potatoes were raised on a large scale to serve as an admixture to the beet molasses for alcohol manufacture in order to render the refuse from the still of more value for feeding purposes.

salt is largely supplied as a fertilizing agent, it is natural that the sugar beet should manifest a tendency to return to its more primitive form, the common fodder beet. The recommendation of the direct application of the Stassfurt salines for fertilizing purposes in the case of the sugar beet will appear to many readers of my report on sugar-beet cultivation, of 1871, of rather doubtful merit, and apparently somewhat in contradiction with previous statements. They will remember, in all probability, the objection raised against the selection of lands which from natural causes contain a large accumulation of the various saline constituents of plants resulting from the decay of successive generations of vegetation, as woodlands and prairies but recently put under cultivation. These lands are not fit in their original state for the cultivation of a good sugar beet, because their mineral elements find more than their equivalent of suitable organic and particularly of nitrogenous plant-food which favors a luxuriant growth altogether different from what the beet-sugar manufacturer desires. Large quantities of nitrogenous and non-nitrogenous compounds peculiar to this species of plant enter it, and carry their corresponding quantity of mineral constituents with them, which of course will also be present in an extraordinary amount. These very same lands, if of a more sandy than clayish nature, with a permeable subsoil, may prove, in consequence of repeated cropping, sooner or later, a most excellent soil for the cultivation of the sugar beet. It is, after all, a good physical condition of the soil which in the hands of an intelligent farmer will most surely in the course of time turn the scale of profit in his favor. Silesia, where the beet-sugar industry of Europe originated, falls, in spite of equal skill and perseverance, considerably behind other districts in its average yield of roots per acre, in consequence of a less favorable soil. Neither much exhausted lands nor such as are above described offer encouraging prospects for a first trial of the beet-sugar industry. No sugar beet can be raised without potash, or without phosphoric acid, and the same may be said about some of its other constituents, though we rarely call attention to this latter fact because the natural supply is usually sufficient. Soda, in case of a deficiency of potassa, will serve to a limited extent as a substitute. Sulphuric acid may replace in the same way phosphoric acid, and magnesia, lime, but

neither of the various constituents alone stands in any fixed relation to the percentage of sugar, except the potash or rather the sum of the alkalies (Stohmann).

II. On the Quality of the Sugar Beets Raised.

A good sugar beet has the following properties, viz.: Its leaves are numerous, of medium size, not upright, but rather rounded and drooping, and of uniform, light green color; its root is of a moderate size, not exceeding two and one-half pounds; the skin of the root is white and smooth, and its meat hard, white, and of sweet taste; the form of the root is pear or wedge-shaped, very gradually terminating in a long thin tap-root without any side branches; its specific gravity is always less than that of its juice. The specific gravity of a good sugar beet varies, in the majority of cases, between 1.010 and 1.060, though instances are on record where it was found to be as 1.070. Roots between one and two pounds in weight* contain usually a juice of less density and also frequently of less value than those of one-half a pound, and even less weight, and similar conditions have been noticed in regard to their relative proportions of sugar and their other remaining soluble constituents. Roots of a higher specific gravity contain usually less of these latter constituents in their juice, and their gravity varies within quite narrow limits from 2.0 to 2.7 per cent., whilst the juice of roots of a lower specific gravity usually contains not only more impurities, but what is of particular importance, because of more general occurrence, these foreign soluble substances are present in larger quantity, namely, from 2.7 to 5.0 per cent. and more. The following two facts will be apparent from the previous statements, namely: that no strictly reliable deduction can be drawn from the specific gravity of the sugar-beet root in regard to the value of the juice, nor from the specific gravity of its juice in regard to its percentage of sugar, beyond the general assumption that, in most cases, the larger roots (two to three pounds) of the same quality of sugar beets are inferior to the smaller specimens. Individual roots of the same variety, raised upon the same field and under the same

* The excellent pictures of sugar beets in my first report were sketched from specimens raised upon the college farm by Mr. Samuel T. Maynard, of Northborough, Mass., a member of the present senior class.

treatment, even when of the same size, are known to differ in regard to their composition as far as their saccharine quality is concerned (Stammer). The quality of a sugar-beet crop, therefore, can only be safely decided by testing a large number of roots of various sizes from different portions of the field, and accepting the mean of a series of such examinations as the most probable actual condition of the entire crop. All tests have to be made without any unnecessary delay, for beet roots, like other roots, lose moisture on exposure to the air, and suffer thereby more or less serious alteration, which, if not taken into consideration, must result in mistakes. The increased density of the juice will be followed by a corresponding smaller yield. The loss noticed during an ordinary state of the atmosphere amounted at a temperature from 15° to 18° C. to 2.6 per cent. within thirty hours and to 13.1 per cent. within eight days, whilst at a temperature from 30° to 40° C. it reached 23.0 to 25.0 per cent., and the internal changes as far as the crystallizable sugar is concerned are, in the latter case, still more serious.

A sound, fresh, full-grown sugar-beet root is free from grape sugar and from ammonia, yet both compounds will be noticed sooner or later in a beet root after its removal from the soil, and subsequent exposure to a temperature which favors fermentation. The practical sugar-beet cultivator recognizes this fact by placing the roots, after their removal from the soil and their separation from the leaves, without much delay in pits. A lacerated beet root decays rapidly. The beet roots raised upon the college farm, on the whole, showed the characteristics of good specimens, having in the majority of cases a smooth and white skin, and white, hard and sweet meat, being remarkably compact, of good form, and generally free from branching roots. The main bulk of these did not exceed one and one-half pounds in weight, specimens from two to three pounds in weight having been rather scarce. The outer leaves turned yellow toward the middle of September, indicating the ripeness of the roots. My laboratory tests for determining their percentage of sugar began on the tenth of September.

1. *Determination of the amount of water.*

13.818 grammes of carefully cut, thin slices of the Imperial sugar-beet root were loosely packed between a given weight of

dry blotting paper and kept in an air bath at a temperature from 100° to 105° C. until a constant weight was obtained; the loss amounted to 11.328 grammes or 81.98 per cent. of water. Again, 9.191 grammes of the same beet root were dried under corresponding conditions; the loss amounted to 7.502 grammes or 81.74 per cent.

Imperial Sugar-beet Root.

	I.	II.
Volatile matter, ...	18.02	18.26
Water, ...	81.98	81.74

A good sugar beet contains usually from 81 to 82 per cent. of water, yet it may vary from 79 to 86.63 per cent. of water, and from 13.37 to 21 per cent. of dry substance.

2. *Tests of the juice.*

The juice of the roots, of the tops, and of the main parts of the leaves differs widely; an analytical statement concerning these points* will be found quite instructive here.

(Mehay.)

	Juice of Root.	Leaf Stalk.	Leaf.
Sugar, crystallizable, ...	12.00	0.25	0.00
Sugar, uncrystallizable, . . .	0.50	2.72	1.23
Oxalic acid, ...	0.22	0.43	1.86
Specific gravity, ...	1.060	1.023	1.025

The sugar was determined by means of fermentation by Dubrunfaut's method.

*Mehay; comptes rendus, T., lxix., p. 754. Heidepriem; Zeitschrift, xix., S. 75. Stohmann; Zeitschrift, xix., S. 273. Stammer; Jahresbericht, 1869.

(HEIDEPRIEM, 1869.)

	Juice of Root.	Juice of Top.
Specific gravity,	1.0648	1.0572
Sugar,	13.6800	10.2100
Soluble substances, without sugar,	2.0200	3.3900
Organic substances, without sugar,	1.4600	2.4600
Ashes, less carbonic acid,	0.5600	7.2000
Protein substances,	0.8870	1.7500

(STOHMANN, 1869.)

	Sugar-beet Juice.	
	Minimum.	Maximum.
Sugar,	9.56	17.680
Soluble substances, without sugar,	0.38	3.510
Potassa,	0.09	0.255

The amount of other soluble substances for every 100 parts of sugar in the beet juice, varies from 8 to 18.50 parts. The specific gravity of the beet juice is usually ascertained by Brix's saccharometer, an instrument which refers to percentages of pure sugar in distilled water. As the beet juice contains besides sugar a variety of organic compounds, its indications are only of interest for comparative tests. The exact amount of dry substance in the juice has to be decided by a careful evaporation to dryness. The percentage of sugar in the juice from the same beets may differ somewhat in consequence of different ways of obtaining it. The juice obtained by a centrifugal apparatus and that extracted by hand pressure were noticed to differ about 0.7 per cent., the latter being the richer juice, while that obtained by a powerful press may exceed even this by 0.1 to 0.66 per cent. These few general remarks may serve to place some of my subsequent analytical statements in their proper light.

3. *Determination of the sugar in the juice.*

Most of the sugar tests were made by means of an excellent Dubosq-Soleil's optical saccharometer. In some instances, the

results thus obtained have been verified after converting the entire amount of cane sugar present into grape sugar; in other cases, particularly where the Dubosq's apparatus gave high results, I verified the optical test by a chemical test, by the use of Fehling's well-known solution. The juice for my experiments was produced, where not otherwise directly stated, always in the following way. A number of sugar-beet roots of various weights, which were collected from the five divisions of the field, were freed from the tops as far as the leaf-marks extended. The roots were subsequently ground by hand upon a common tin grater, and the pulp resulting pressed by hand in a strong cloth. In a few instances, when a larger number of roots were to be pressed for juice, they were cut by an ordinary root-cutter and pressed by a common iron screw press. The juice, after being obtained in either of these ways, was either allowed to settle or strained through a cloth, and then tested in regard to its specific gravity by means of a Brix's saccharometer. The preparation of the juice for the tests with the polariscope was carried out in the following manner: 500 cubic centimeters of the juice were poured into a graduated glass cylinder, and subsequently thoroughly mixed with 50 C. C. of a solution of subacetate of lead of the usual concentration.* As soon as a light colorless solution began to separate from the bulky precipitate, the whole mass was put upon two filters of coarse paper and quickly filtered, and the juice thereby obtained was again without delay filtered through 150 C. C. of medium-sized, coarse boneblack. The first 100 C. C. of the filtrate were set aside and the subsequent filtrate turned to account for the optical test in the usual manner. I removed 100 C. C. of the filtrate, its first portion, for the purpose of rendering the solution for the tests independent of the incidental influences of boneblack, its moisture, &c. This mode of proceeding was adopted to allow a direct comparison of my results with numerous other investigations of a similar character and for similar ends.

The polariscope was in each case adjusted with a carefully prepared standard solution † of pure sugar, and also with water.

* Digest one part of acetate of lead, one part of oxide of lead, and twenty parts of water at 30° to 40° C. from six to ten hours and filter.

† 1000 C. C. water containing 163.50 grammes of pure sugar in solution when put into a tube of 200 millimeters in length produces the same rotation which a quartz plate

The number of degrees required to produce the optical effect of presenting but one color were increased by one-tenth of their number to compensate for the dilution of the original genuine beet juice by means of the lead solution used for its defecation, each degree representing 0.1635 per cent. of sugar. The results of my tests will be given in a chronological order. They refer mainly to sugar beets and other beet roots raised upon the college farm, while an appendix contains also a few tests concerning sugar beets grown elsewhere in the State.

Sugar Beets from the College Farm.

	Weight of Roots with Tops.		Weight of Leaves.	
	Lbs.	Oz.	Lbs.	Oz.
Sept. 12, 1871. Imperial sugar beet from seed imported in 1870,	1	14	1	0
	1	4	-	13
	1	10	-	13
	1	13	-	11
	1	12	-	10.5
	8	5	3	15.5

Juice, 15° Brix, at 64° F.; per cent. of sugar, 12.59.

	Roots and Tops.		Leaves.	
	Lbs.	Oz.	Lbs.	Oz.
Sept. 13. French Vilmorin beet from imported German seed of 1870,	1	9	1	3
	2	4	1	1
	1	5	-	12.5
	1	5	-	12
	1	11	1	8
	7	2	5	4.5

Juice, 14.5° Brix, at 65° F.; per cent. of sugar, 12.95.

of one millimeter thickness will produce. 100 C. C. of water containing 16.35 per cent. of pure sugar in solution when examined in a tube 200 M. M. in length indicates directly the percentage by means of degrees.

	Roots, with Tops.		Leaves.	
	Lbs.	Oz.	Lbs.	Oz.
Sept. 10. Electoral beet, from seed imported in 1870,	1	1	1	7
	1	1	-	11
	1	1	-	13
	1	0.5	-	15
	1	4	-	14
	5	7.5	4	12

Juice, 14° Brix, at 62° F.; sugar, 12.30 per cent.

Oct. 11. Imperial beets; seeds imported, 1870. Two hundred and fifty pounds of these roots, without tops, were cut by a common root-cutter and pressed in an iron screw press. The roots were moist from washing before cutting. Juice, 15° Brix, at 73° F.; sugar, 12.05 per cent.

Oct. 16. Electoral sugar beet; seed imported 1871. Four hundred and ninety pounds of roots, without tops, cut by a root-cutter and pressed by an iron screw press. Juice, 15° Brix, at 54° F.; sugar, 12.22 per cent.

Oct. 18. Vilmorin sugar beet; seed imported 1870. Six hundred pounds of roots, without tops, cut by a root-cutter and pressed by an iron screw press. Juice, 16° Brix, at 60° F.; sugar, 13.129 per cent.

	Roots, with Tops but no Leaves.	
	Lbs.	Oz.
Nov. 14. Imperial beets taken from the pit,	1	8
	-	13 5
	1	4.5
	-	13
	-	10.5
	-	13
	5	14.5

Juice, by hand press, 15° Brix, at 64° F, 1.064 to 1.065 specific gravity; sugar, 11.60 per cent.

Nov. 21. Vilmorin Beet, from the pit. One root, with top, weighing one pound 12 ounces. Juice, 15 5° Brix, at 68° F.; sugar, 13 12 per cent.

Fodder Beets.

	Roots and Tops.		Leaves.	
	Lbs.	Oz.	Lbs.	Oz.
Sept. 19. Vienna red, yellow, and white globe beets, ...	2 1 3	2 8 1	- - -	12 10 10
	6	11	2	-

Juice, Brix 11° at 65° F ; sugar, 8 004 per cent.

	Roots, with Tops.		Leaves.	
	Lbs.	Oz.	Lbs.	Oz.
Sept 19. Ordinary Mangolds, red and yellow. Seeds sent from the National Agricultural Department, . . .	1 1 1	0½ 1 12	0 0 0	5 2 12
	3	13½	1	3

Juice, Brix 9° at 66° F.; sugar, 5 035 per cent.

Sugar Beets sent from other parts of the State.

[From the Imperial seed, imported 1871.]

	Roots, with Tops (somewhat withered).	
	Lbs.	Oz.
Nov. 7. Hon. S. Williston, of Easthampton, Mass.,	1 2 2	6.50 11.25 14 0
	6	15 75

Juice, 12.39 per cent. of sugar by polarization.

	Roots, with Tops (somewhat withered).	
	Lbs.	Oz.
Nov. 22. William Knowlton, Esq., of Upton, Mass., ...	1	10
	1	4
	1	11
	1	10
	1	12
	2	3
	1	4
	11	6

Juice, Brix 15° at 55° F.; sugar, 10.07 per cent.

	Roots, with Tops.	
	Lbs.	Oz.
Nov. 10. Dr. N. Durfee, of Fall River, Mass., . .	2	0½
	1	9
	2	5
	2	11
	8	9 5

Juice, Brix 15.5° at 60° F.; sugar, 10 45 per cent.

A large specimen of the American Improved Imperial sugar beet of Hon. Henry Lane of Cornwall, Vermont, recommended for stock feeding and raised at Williamstown, Mass., was tested at the request of Hon. P. A. Chadbourne. This beet root had been for several days on exhibition at the fair of the Hampshire Agricultural Society at Amherst, Sept. 27, 1871, and was consequently in a somewhat dried up state; it was spongy, partly hollow and weighed between seven and eight pounds. Juice, Brix, 15° at 58° F.; sugar, 6.67 per cent.

For the purpose of verifying the results of the optical analysis, I selected one of the best beet roots (the Vilmorin of November 21) and subjected its juice to a chemical test. I

took 100 C. C. of the juice prepared with a solution of subacetate of lead (one-tenth vol.) for the test with the polariscope and precipitated the excess of lead by means of diluted sulphuric acid. I added then an excess of sulphuric acid and digested the mixture for several hours at a temperature of from 60° to 80° C. to convert the cane sugar to grape sugar, and neutralized, subsequently, with carbonate of soda, and diluted the whole to 500 C. C. In two successive tests, I noticed that four C. C. of that solution were sufficient to reduce twenty C. C. of Fehling's solution. These results prove that 500 C. C. contain 12.5 grammes of grape sugar, for 10 C. C. of Fehling's solution are equal to 0.050 grammes of grape sugar (or 0.0475 grammes of cane sugar). Adding to 12.5 grammes one-tenth more, for the dilution by the subacetate of lead solution, we find that the original beet juice contained 13.75 per cent. of grape sugar, or 13.09 per cent. of cane sugar, the form in which the juice contains its sugar. Similar results were obtained with the polariscope, after the inversion of the cane sugar by means of concentrated hydrochloric acid.

5. *Determination of the solid residue of the juice.*

I selected for this purpose a variety of sugar beet which, comparatively speaking, with a low percentage of sugar, had shown a high specific gravity of its juice. Two different samples, each 100 grammes, of an Imperial sugar-beet juice (November 14th) were evaporated carefully in an air-bath to dryness, and the residue finally kept at from 100 to 105° C. until no further loss could be noticed. The solid residue varied from 15.06 to 15.10 per cent. As the sugar found in that juice amounted to 11.60 per cent., we learned that its entire amount of organic and inorganic non-volatile substance after the deduction of the sugar was equal to 3.40 per cent. The juice of that Imperial beet consisted therefore of

Solid matter (containing 11.60 per cent of sugar),	15.10 per ct.
Water, ...	84.9 "
	100.00 per ct.

The results of Brix's saccharometer and of the sugar tests together are usually turned to account to give some idea about

the percentage of foreign matters in a beet juice. For instance, in the case of the preceding examination, we notice 15° Brix as the specific gravity; the actual evaporation proves that each degree corresponds in that case quite closely with one per cent. of matter in solution.* This assumption is not strictly exact, yet it gives for ordinary practice quite valuable indications. Subjecting then all previous investigations of beet juice to this mode of representing their value in a general way, we obtain the following figures:—

		Brix's Saccharometer.	Sugar, per cent.	All substances in solution, except sugar.
	Beet, juice of,—			
Sept. 10,	Electoral, . . .	14°	12.30	1.75
12,	Imperial (1870), .	15°	12.59	2.41
13,	Vilmorin (1870), .	14.5°	12.95	1.55
18,	Imperial (1871), .	14°	10.79	3 21
Oct. 11,	Imperial, . . .	15°	12.05	2.95
16,	Electoral, . . .	15°	12.22	2.78
18,	Vilmorin, . . .	16°	13.13	2 87
Nov. 14,	Imperial (1871), .	15°	11.60	3.34
21,	Vilmorin, . . .	15.5°	13.12	2.38

We notice that the Imperial beets from seed imported in 1871 differ considerably from the rest, and are quite inferior to them, whilst the latter average very well, viz.: 12.63 per cent. of sugar to 2.38 per cent. of other soluble substances, or 100 parts of sugar to 18.8 parts of the others. The inferior Imperial stands, on the average, as 11.19 per cent. of sugar to 3.275 per cent. of other soluble substances, or 100 parts of sugar to 29.20 parts of the others. The *fodder beets* differ still more, as will be seen from the following statement:—

		Brix.	Sugar.	Non-saccharine substances.
Sept 19,	Vienna globe, . . .	11.0°	8.00	3.00
	Common mangold, . .	9.0°	5.00	3.97

Or Vienna, 100 parts of sugar to 37.5 of other soluble substances.
Mangold, 100 parts of sugar to 79.5 of other soluble substances.

* The saccharometer used in my tests has for its smallest division one-half degree instead of one-tenth as would be desirable.

5. *Determination of the nitrogenous constituents of the beet juice.*

One hundred grammes of the juice of an Imperial beet, (November 14) containing the largest proportion of foreign admixture in its juice, were used for this test, its solid dry residue amounting to 15.10 grammes. The analysis for the percentage of nitrogen was carried on in a Bohemian glass tube and in the well-known manner with caustic soda and lime, taking particular care to apply a decided excess of the mixture to secure a thorough combustion of the highly carbonaceous mass. The ammonia resulting was collected by means of moderately concentrated (1.12 spec. grav.) hydrochloric acid in a Will-Varrentrap's apparatus, and its amount determined in the form of platin-ammonium chloride. 2.0660 grammes of dry, pulverized residue of the beet juice produced 0 515 grammes of platin-ammonium chloride, which is equal to 3.761 grammes of the entire dry substance of the beet juice (100 grammes).

1.912 grammes of the same residue produced 0.470 grammes of platin-ammonium chloride, which is equal to 3.6881 grammes for the entire residue. As 223.20 parts of the platinum compound contain seventeen parts of ammonia and fourteen parts of nitrogen, which is equal to 6.2724 per cent. of the latter, our results correspond to the following figures: 3.761 grammes of platin-ammonium chloride are equal to 0.2359 per cent. of nitrogen, and 3.6881 grammes to 0.2315 of nitrogen. In case we assume that the whole amount of nitrogen found is present in the form of nitrogenous or albuminous substances, we may, by multiplying the percentage of nitrogen found by 6.25, ascertain the amount of those compounds. The average of nitrogen found is $0.2337 \times 6.25 = 1.460$ of albuminous substances. This assumption is, however, not exactly supported by facts, for the beet juice contains, besides the albuminous substances, two other nitrogenous compounds quite distinctly differing from the former, namely, asparagin* and betain, organic bases for which

* Asparagin was discovered in beet juice as early as 1850 by Dubrunfaut. Betain, a new organic base, was first noticed by Scheibler in 1869. He found that the juice of beet roots, during the month of July, contained one-fourth per cent., while, in the month of October, but one-tenth per cent. was present. Scheibler has since proved the identity of the oxyneurin of Siebreich and anhydrous betain, which can therefore be made directly by treating trimethylamin with monochloracetic acid. Betain has the formula $C^5 H^{11} NO^2$.

due allowance of nitrogen has to be made, which very naturally reduces more or less the amount of albuminous substance previously calculated. The albuminous substances generally vary in a good sugar-beet juice from 1.3 to 1.4 and the amount in the juice from beets raised upon the college farm cannot exceed that. It was deemed important to ascertain how much of these substances can be removed from the beet juice by means of an ordinary defecation or clarification in the course of the beet-sugar manufacture. In making these tests, it seemed necessary to treat the juice from two different varieties of sugar beets, yet raised upon the same field and under identical conditions.

Two hundred grammes of the juice from the Electoral sugar beet (October 16th) were heated quickly yet carefully in a glass flask to 80° C., when two grammes of caustic magnesia (free from lime) were added with thorough stirring after the removal of the glass from the source of heat applied. The mixture was then heated again, without unnecessary delay, until the steam formed at the bottom began to force its way through the solid curdy scum upon the surface of the liquid. After having kept up the temperature to from 95° to 98° C. for about ten to fifteen minutes, the mixture was placed upon a weighed filter, and the solid residue left upon the filter after the filtration subsequently washed with 200 C. C. of distilled water at ordinary temperature before drying. The residue, after desiccation in the air-bath at 100° C., weighed 4 776 grammes, which is equal to 2.388 per cent. An analysis of 2.388 grammes with caustic soda and lime produced 0.6172 grammes of platin-ammonium chloride, which being equal to 0.0387 per cent. of nitrogen, shows that but 0.2346 per cent. of albuminous substances have been precipitated by heat and caustic magnesia.*

Two hundred grammes from the juice of the Vilmorin beet (October 18th) were treated with two grammes of caustic lime in the same way as in the preceding test with caustic magnesia. The caustic lime being to a much larger degree soluble in a solution of sugar than the magnesia, only 3.849 grammes of dry precipitate were obtained. 1.9250 grammes of that residue produced 0.5060 grammes of platin-ammonium chloride, which

* See Contribution on the Manufacture and Refining of Sugar, by C. A. Goessmann, Syracuse, 1864; also, Chemical News, by W. Crookes, London, 1864.

is equal to 0.1923 per cent. of albuminous substances. Comparing the results of these tests, we notice that in the case of caustic magnesia nearly one-fifth more of nitrogenous substances was rendered insoluble than in the case of caustic lime, while in both cases but a small fraction (one-fifth to one-sixth) of these compounds is rendered insoluble.

6. *Determination of the ash constituents of the beet juice.*

The beet juice produced by the press contains more saline compounds than the press-cakes left behind, while the ashes of the latter contain more carbonic acid than those of the former. In both cases, the carbonic acid originated from the destruction of organic substances. How much the mode of abstracting the juice from the sugar beets affects the quantity and quality of the saline constituents of the beet juice, I have already sufficiently pointed out and illustrated by analytical statements in my previous report. The various kinds of fertilizers applied are also known, as stated before, to affect the relative proportion of the various saline constituents of the press juice to some limited extent, and in a manner previously explained, yet the total amount absorbed, even in the case of the Stassfurt salines, varies but little, provided the soil is not overcharged with organic and particularly with nitrogenous organic plant-food. A good sugar beet contains always at least three times as much potash as soda, and often even a larger proportion, but excessive applications of common salt as a manure are known to increase the relative amount of soda. The following inorganic constituents are usually found in the juice of the sugar beet, viz.: potassa, soda, lime, magnesia, iron, phosphoric, sulphuric and silicic acids and chlorine. Of these, the alkalies are of main importance so far as the sugar question is concerned, for they exert a specific influence on the results of our ordinary modes of manufacture. Their great solubility, and their peculiar indifference towards the absorbing property of boneblack carry them largely as an obnoxious feature through all the operations down to the molasses. Only the determination of the potassa and soda is for this reason a quantitative one, whilst the remaining saline compounds are stated collectively as percentages of the ash constituents.

Five hundred grammes of Vilmorin (October 18th) beet

juice were carefully evaporated and gradually charred, until no vapors arose, and the compact, hard, carbonaceous mass was subsequently kept at a low red heat until it formed a very friable mass. The latter, after cooling, was finally ground, and for some time digested at ordinary temperature with distilled water to prevent as much as possible a mutual decomposition of the ash constituents. After the mass had been digested for some time, it was placed upon a suitable filter and subsequently washed with cold water, making the entire amount of the solution about 500 C. C. This solution, after its evaporation to dryness, and a re-solution, etc., left 0.928 grammes of alkaline compounds or 0.185 per cent. A direct examination proved that it contained 0.762 per cent. of potassa and 0.012 per cent. of soda. Against this mode of proceeding, I am aware may be said that its results are not strictly exact, as traces of alkalies will be left behind in the carbonaceous mass, but it appeared to me that the risk of a trifling loss was less serious than that caused by excessive heating to destroy the carbon.

One hundred grammes of Imperial beet juice (November 20th) were carefully evaporated and charred. The carbonaceous mass was then mixed with concentrated sulphuric acid and heated in a platinum dish to oxidize the carbon. This operation was repeated until no carbon could be noticed, and the residue moistened again with sulphuric acid was brought to a dull red heat, and subsequently weighed. It amounted to 1.273 grammes or 1.237 per cent. Making the customary allowances for sulphuric acid (one-tenth of the weight of the saline residue) we find the entire ash constituents of the juice equal to 1.145 per cent. The amount of salines in the beet juice is, of course, much larger on account of the presence of the organic acids than the ash percentage represents.

I stated before that the amount, and particularly the kind of saline constituents in the beet juice is of great importance to the beet-sugar manufacture, for their amount even under favorable conditions is considerable, and they interfere more or less directly and indirectly with an advantageous separation of the sugar in well-developed crystals, and not unfrequently increase the amount of molasses at the expense of the sugar. The manufacturer feels thus obliged to direct his attention very carefully during the entire process of manufacture towards this

point. He finds it for his interest to begin operations with a sugar-beet root having a small percentage of saline compounds, and supplies himself with water which contains but a small amount of mineral matter.* He removes the alkalies by washing from the caustic lime before using it for defecation, and strives also to remove every cause which might bring about such changes as will render the juice acid or induce the formation of acids, for they favor the introduction of otherwise insoluble compounds into the sugar solution, such as sulphate, phosphate and carbonate of lime, etc. Finally, he avoids the use of any organic or inorganic substances for the clarification of the sugar solutions which in consequence of their own composition are liable to increase the amount of soluble salines present. The means by which these compounds may be removed are costly, and, in regard to the alkalies in particular, very inefficient. Although the frequently cited statement that 1 per cent. of ash constituents will render from 4.5 to 5 per cent. of a good sugar uncrystallizable is not true in its general application, yet sufficient is known to justify the assertion that their presence is highly objectionable. Some salines, as caustic potassa and soda, carbonate of potassa, acetate of potassa, and a few other combinations of the latter base with organic acids, are known to prevent directly more or less sugar from crystallizing, whilst the others, collecting in the molasses to a considerable proportion, increase its bulk and thus indirectly cause the retention of more or less sugar in a form of low value. Beet molasses contains about 45 to 50 per cent. of sugar and from 9 to 10 per cent. of ash constituents, the latter representing in all probability more than twice their weight of salines in the original solution, where the bases are combined with several organic as well as mineral acids.

III. On the Separation of the Sugar.

The juice of the sugar beet for the manufacture of sugar is secured in various ways. The roots, after being freed from leaves, are washed and their crowns cut off as far as the leaf-

* Stammer states that, in case of the press mode being used, every 100 pounds of beet-roots require 62 pounds of water; in case the maceration and diffusion modes are to be applied, from 180 to 200 pounds of water are needed usually for every 100 pounds of beets, provided white sugar is to be made.

marks extend. They are subsequently changed by means of suitable apparatus either into pulp, and in that state subjected to the action of a powerful press, or centrifugal apparatus, or both operations successively, or they are cut into suitable slices and macerated or subjected to a process of diffusion. Each mode of operation quite naturally affects to some extent the quantity, the kind, and the relative proportion of the constituents which accompany the sugar in the resulting juice. None of these modes produces a solution directly fit for the separation of the sugar by its mere evaporation and subsequent crystallization. Any of these juices in their original state soon turn slimy and their sugar will rapidly become uncrystallizable and thus be entirely lost to the manufacturer. All have, therefore, without delay, to undergo a similar process of purification before an advantageous separation of its sugar can be expected. It may be of interest to state here somewhat more in detail the main organic and inorganic constituents of the beet juice. They are cane sugar, pectose, fat, gum, protein substances, asparagin, betain, oxalic acid, citric acid and extractive matter (a collective name for organic substances but little known), besides potassa, soda, rubidium,* lime, magnesia, iron, manganese, phosphoric acid, sulphuric acid, chlorine and silicic acid. As the various constituents of the beet juice obtained by pursuing any of the previously mentioned modes of separation are either identical or at least of a similar character and as they mainly differ in regard to their relative quantities, the same general mode of manufacture with but slight modifications, is practised for the final separation of the sugar. Instead of inserting here a chapter treating on this point more in detail, I prefer to confine myself for the present to the task before me, and to describe the way by which I ascertained the amount of sugar which could be considered as available for commercial purposes. In the course adopted, I adhered as much as possible to the modes and the means which intelligent beet-sugar manufacturers apply, and modified my plan merely to suit the peculiar circumstances under which I was obliged to work.

* Lefebvre states that one hectare (2.5 acres), which produces on the average 40,000 kilos (88,000 pounds) of sugar beets, and furnishes at the same time 128 kilos (281.6 pounds) of crude potash, contains for every kilo of the latter 1.75 grammes of rubidium chloride, or 288 grammes per hectare, or 91.5 grammes per acre. (Compt. rendus, T. liv., page 430, 1862.)

I took fifty pounds of Electoral beet juice (October 18th), in a suitable copper kettle and heated it quickly but carefully to 80° C. to produce the coagulation of the albuminous substances. I then removed the vessel from the source of heat and stirred into the liquid one-half of one per cent. of caustic lime, which had been changed into milk of lime. The heat was then applied again and the liquid rapidly raised to its boiling point, and as soon as the steam produced at the bottom of the vessel began to force its way through the compact mass of scum covering the surface, the heat was discontinued and the clear liquid was separated from the scum, after ten to fifteen minutes standing, by means of a siphon. The scum itself was subsequently placed upon a filter consisting of cloth and the filtrate passed through a thin layer of coarse boneblack to render the juice clear. The previous treatment of the juice of the sugar beet, which is called the process of defecation, aims at the following alteration of its constituents. The heating of the juice at 80° C causes the coagulation of the albuminous substances which protects them somewhat against the disintegrating reaction of the caustic lime, and particularly of the caustic potassa and soda, which result from the action of the caustic lime upon the organic and inorganic compounds of these alkalies in the beet juice. The excess of caustic lime renders, at a higher temperature, the oxalic acid, the citric acid, and the phosphoric acid largely insoluble, and causes thus their partial removal in common with gum, fat, pectose, and extractive substances in the form of a precipitate. The asparagin is changed into asparaginic acid and ammonia, which continually escape, with that amount of the latter which results from the constant decomposition of a portion of nitrogenous substance which remained in solution. The organic base, betain, is liberated from its combination with one of the organic acids, and, being very soluble, accompanies the larger proportion of the compounds of the asparaginic acid and the alkalies through the various operations connected with the crystallization of the sugar into the molasses. The sugar forms a definite soluble combination with lime and by its presence keeps also a large amount of otherwise insoluble lime compounds in solution.*

* A well defecated juice contains about twice as much caustic lime in solution as lime water does.

There are various rules regarding the amount of caustic lime required to accomplish the desired result of an economical separation of the sugar from its accompanying substances, but they all aim at an excess of caustic lime in the process of defecation. The excess favors the formation of insoluble basic lime compounds, the subsequent disintegration of soluble albuminous substances, and particularly it shortens the entire process of defecation, a result most desirable for the production of a copious precipitation, which would be more or less interfered with in case the liberated alkalies were permitted to continue their disintegrating influence upon the scum for any length of time. A successful defecation, considering everything else equally favorable, aids in an unusual degree the entire subsequent process. To remove the foreign substances from the beet juice rather by precipitation than by disintegration ought to be the aim of the beet-sugar manufacturer, yet those who claim superior results (Jelinske) it seems remove but fifty per cent. of soluble non-saccharine constituents of the juice. No other process connected with the beet-sugar manufacture has been more frequently discussed than that of defecating the juice, and there prevails a greater diversity of opinion among manufacturers on that point, with the exception probably of the most efficient and at the same time the most economical means of securing the juice from the roots, than on any other point connected with the business.

The defecated juice, obtained as above described, was of a light yellow color, transparent and of a strong alkaline reaction. To secure the full effect of the lime in solution, I concentrated the juice in an open copper vessel by means of a steam bath to 30° Brix, and treated it at 50° C. with carefully washed carbonic acid gas until the precipitate of carbonate of lime settled readily to the bottom.* The clear solution was heated to 95° to 100° C. and subsequently passed through a boneblack filter, which was kept by means of steam at 95° C. I used one pound of boneblack for every pound of sugar in the juice. The solution thus obtained was carefully evaporated to crystallization and the sugar collected at three different times. It

* From 0.08 to 0.09 per cent. of caustic lime is frequently left in solution to be removed by boneblack afterwards. From ten to twenty pounds of boneblack are used for every 100 pounds of beet-roots.

amounted to somewhat more than eight per cent. with separation still going on slowly. The operation was several times repeated with the juice of the Electoral, and of the best Imperial beet, and the sugar resulting was firm in grain and of good color. Experiments on a smaller scale yielded from a juice which contained 13.19 per cent. of sugar, 9.4 per cent. in a crystallized form, which has been valued by experienced sugar refiners at from 8.5 to 9 cents per pound for refining purposes. Being obliged to work without a vacuum pan, &c., and obtaining as stated eight per cent. of a good sugar worth at least eight cents per pound, I feel quite entitled to say that the sugar beets raised upon the college farm, particularly the Vilmorin and the Electoral, though not of the highest order, are well qualified for the economical manufacture of beet sugar. With proper care in selecting good seeds and a fit soil, it is quite apparent that the sugar beet promises with us as good results as in Europe. Our long and moderately warm fall season may even give us a decided advantage over many localities in Europe, a question which good native sugar beets are most likely soon to decide.

Our method of planting the sugar beet did not promise more than 18,000 plants per acre, which according to our actual test produced roots equal to about one and one-fourth pounds each. In case the implements on hand would have allowed to carry out the proposed arrangement (the rows but twenty inches apart and the individual plants eight inches from each other in the rows), from 28,000 to 28,500 plants might have been raised, which at the same average weight of the roots would amount to 32,000 or 34,000 pounds per acre. At this rate of production, it is quite safe to say that from 1,900 to 2,000 pounds of sugar would be its produce per acre. These figures, which are as will be conceded well supported by actual tests here and elsewhere, oblige me to alter the valuation of the produce per acre from that of my first report. For obvious reasons, I adopt here again rather the lowest rates than the higher ones, although the field on which the experiments were made was by no means equal in fertility to the alluvial soil of the Connecticut.

Sugar, 1,900 pounds at eight cents per pound, . .	$152.00
Molasses for feeding purposes, ...	3.66

Press-cakes, $17.40, crowns, $4.00, ...	$21.40
Leaves, as manure or fodder, ...	12.00
	$189.06

To this amount should be added the profit on fodder converted into milk, beef and manure.

Making allowance for exceptionally good results, which are in Germany, for instance, 2,270 pounds of sugar per acre, $29.60 would have to be added to the above sum. Adding one cent to the value of each pound of sugar, which considering our present market prices seems to be warranted, would be $15.20 more, making the entire yield $222.86 per acre. There are, also, incidental profits arising in the manufacture of sugar, which benefit particularly the agricultural interest, which were not enumerated in my former report. Two sources of additional profit deserve particular attention here. The process of defecation requires the application to the juice of from one to several per cent. of caustic lime. The scum resulting from this operation contains a large percentage of phosphoric acid, magnesia, nitrogenous and non-nitrogenous organic constituents of the beet juice, a considerable quantity of caustic and carbonate of lime, and these are in such a state that they may serve, after some composting, as an efficient fertilizer. In its original condition, it consists of about 60 per cent. of water, 22 per cent of organic substances, and 18 per cent. of inorganic substances, and has been counted in this state equal to its own weight of stable manure. This mass is frequently pressed to save sugar, and varies of course somewhat in its composition. One acre of beet-roots causes the production of about 750 pounds of pressed scum of the following composition:

Caustic and carbonate of lime, ...	254.80	pounds
Potassa and soda, ...	3.00	"
Magnesia, ...	14.20	"
Phosphoric acid, ...	14.20	"
Sulphuric acid, ...	.30	"
Nitrogen, ...	11.80	"
Organic substances, ...	300.00	"
Water, ...	151.70	"
	750.00	pounds.

The refuse matter (spodium), resulting from the clarification and decolorization of the sugar solution, is also worth mentioning in this connection, as an important source of an excellent material for the manufacture of super-phosphate. The peculiar benefits which the agricultural interests of a country derive, directly or indirectly, from the introduction of the beet-sugar industry, under judicious management, have never been seriously questioned. I express but the prevailing opinion of European agriculturists, when I again assert, that wherever the promotion of rational principles in agricultural pursuits is a desirable object, or where a declining productiveness of the soil calls for efficient assistance, there it will be found of inestimable service to study the ways and means by which the true relation of the various farm crops to the sugar beet have been ascertained, and the beet-sugar manufacture rendered a lucrative agricultural and industrial business.

The great interest which of late has been manifested throughout the entire country in regard to the introduction of the beet-sugar manufacture, is a sufficient proof that its importance begins to be realized. The question has reached in the minds of many already a state which leaves no further choice for arguments than the laboratory, the field and the factory. We have, in many respects, an easier task and less discouraging prospects, when contemplating the introduction of the beet-sugar manufacture, than those who began this enterprise years ago in Europe. They had first to find out how to raise a good sugar beet, and how to separate in an economical way the sugar, whilst we may, simply, for the present, follow their teachings, ascertain the results upon our soil, and modify their methods to suit our circumstances. They were not less confronted by the same difficulties in their time, which are held up to us as great obstacles in the way of success, namely; an uncertain degree of protection for a struggling home industry and too expensive labor by hand to compete with the colonial sugar produce of the West and East Indies. Their times were indeed hard and their chances* frequently doubtful; yet in looking closer at their

*From 1836 to 1846, about 2,000 pounds of beet roots were required to produce 100 pounds of sugar (=5 per cent.); from 1846 to 1856, about 1,500 pounds of beet roots to produce 100 pounds of sugar (=6⅔ per cent.); from 1856 to 1868, about 1,250 pounds of beet roots for 100 pounds of sugar (=8 per cent.). The government tax is thirty times higher in Germany and France on the beet root than in 1840.

struggle, we cannot help noticing that the very circumstances which seemed at times to render success impossible, have contributed largely to a final good result. A firm belief in the advantages offered by a rational mode of cultivation and by skilled labor over mere empirical routine, carried them successfully to the end. How well they succeeded may be inferred from the following two facts: first, most of the sugar refineries which in former years were engaged in refining sugar from the sugar cane of the tropics, are now refining home-made beet sugar: secondly, the introduction of numerous mechanical contrivances has reduced expensive hand labor in the field and in the factory to a condition which compares very favorably with the relative amounts of machine and hand labor employed in similar industrial operations. Nothing remains for us to do but to enter upon a close investigation of the merits of the question. A study of our resources with reference to the important changes which have taken place in the management of the beet-sugar industry within later years cannot but demonstrate that the prospects are promising. The chief argument used against the introduction of the beet-sugar manufacture as a home industry, rests to-day solely on the expensive field-work which is required to till and to manure the soil properly to cultivate the beet root according to the best rules, and to deliver them at the mill. Although duly recognizing the great weight of this point, for with the farmer rests the success of the enterprise in the end, I believe that its influence as an obstacle is frequently overrated and based on somewhat obsolete assumptions. The government tax of from $40 to $50 per acre of sugar beets, in Germany and France, as well as our higher prices of sugar, will go far towards covering our more expensive labor.* The interests of the Louisiana sugar planters and the sugar-beet cultivators of more northern sections of the country are the same, as far as a proper protection of their industry is concerned; and the public opinion, in view of the requirements of the government, is apparently prepared to accord to them, for some time, at least, this advantage. Great improvements in agricultural implements, and in modes of securing the juice, have reduced labor by hand to a considerable extent. A short enumeration of the most conspicuous

* The average price of the best quality of loaf sugar (crushed) from sugar beets, was, in Germany, during the years 1868 and 1869, but $11 per 100 pounds.

instances may place this statement in its proper light. Various seeding machines, improvements more or less on Garrett's famous seed-drill, are used in planting the seed in four or more rows at once, and at any desired distances from twelve to twenty inches apart. According to the size of the machine, one or two men with one or two horses or oxen, may seed from eight to sixteen acres per day; the same implement can also be modified, by replacing the seed boxes with suitable knives to be used as cultivators, to clean the space between the rows of plants and to cover the roots. Ploughs with two knives are used to break up the soil on both sides of the rows of beets, to loosen the latter in such a manner, without lacerating them, that children may do the harvesting of the roots. In fact, the whole work in the field, after the soil is once properly broken up, calls for no extraordinary labor. A good deal of the work can be done by boys. Machines do the washing, the grinding or cutting, and general handling of the roots to the centrifugal apparatus. The task of handling the pulp of beet roots for the press requires, comparatively speaking, a large supply of hands to do the business connected with that process, but Roberts' diffusion method dispenses with a large number of the hands formerly required in the press-room—nearly one-half.

A report concerning the influence of Roberts' method on the financial results of an establishment which formerly used the press mode for obtaining the beet juice may illustrate the previous statement, and at the same time give some clearer idea about the importance of the labor question, as far as its relative bearing on the financial success of the entire manufacturing operation is concerned. 200,000 pounds of beet roots needed per day (twenty-four hours' actual work) in the press-room, eighteen men, fifty-two girls and twenty-eight boys to perform the handling of the pulp and cakes, whilst after the introduction of the diffusion mode of Roberts, but twenty-six men and ten boys attended to the separation of the juice. The saving of one-half the expenses in that department during a campaign of one hundred and fifty days amounted to much, yet in summing up the entire gain due to a change of operation, it is of some interest to notice that but one-sixth of the extra earnings of the manufacturer was caused by saving in the expenses of labor. I call attention to this instance to show that an extra cost of hand

labor does not affect after all the chances of success to such a degree as is frequently asserted. The margin for profits is larger here than in many other branches of business. The real success of the beet-sugar industry, in its present high state of development, depends, in my opinion, with us far more on an intelligent and close attention to the details of its various operations in the field and in the factory than on any other requirement.*

* My particular thanks are due to Messrs. John E. King and John B. Minor, students of the College, for valuable assistance rendered during my investigations.

REPORT OF JOHN C. DILLON,

Farm Superintendent.

REPORT.

To the Trustees of the Massachusetts Agricultural College.

Gentlemen:—I have the honor to submit for your consideration my report of the farm operations during the past year. The following crops have been raised, viz.:—

	Acres.	Roods.	Perches.
Potatoes,	3	–	15
Oats,	6	1	–
Sugar beets,	4	2	33
Trial wheat,	–	2	36
Vegetable garden,	1	2	31
Corn,	10	2	30
Fodder corn,	1	–	28
Turnips,	2	–	–
Small fruits,	–	2	30
Strawberries,	–	1	18
Hungarian grass,	11	–	3

The land planted with potatoes is a gravelly hill, from which the students, under the direction of Professor Stockbridge, have grubbed up a host of large stumps. The main object of cultivating this land was to subdue the brush and to fit it for the planting of an arboretum. It was planted with potatoes of several kinds, chiefly Early Rose and Bresee's Prolific. Part was manured in the hill with a mixture of ashes, plaster and salt, and part, with about three cwt. to the acre, of different superphosphates. No difference in the crop was perceptible; though the vines, where the superphosphates were used, looked much darker and more luxuriant. The crop was light,—one hundred and twenty-five bushels of large, and seventy-five

bushels of small potatoes. On two rows, where no fertilizer was used, the crop was a total failure.

Another portion of this hill—two acres, two roods, twenty perches—was sown, April 17th, with six bushels Excelsior oats and twenty-five red clover seed. About three cwt. to the acre of superphosphate was sown with the grain and harrowed in. The piece yielded fifty-six bushels of very handsome oats, and there is a clover root which promises a good crop of fodder, and also a valuable amount of fertilizing matter to turn in next August. The rest of the oats were grown on land planted with potatoes last year. Two quarter-acre patches, sown with White Schonen and Excelsior oats obtained from the Department of Agriculture, yielded respectively: Schonen eight, Excelsior ten, bushels. Half an acre of Surprise oats yielded twenty-six bushels, and three-quarters of an acre sown with Excelsior oats, raised on the college farm last year, yielded forty-three bushels.

The beets were grown on land which yielded a fine crop of corn in 1870. The piece was twice ploughed to a depth of eight inches and then worked with Holbrook's Horse Hoe, drawn by a span of horses, harrowed, bushed and planted, the 11th of May, with sugar beets. Five cwts. per acre of different superphosphates were sown and harrowed in previous to planting. The piece was cultivated three times: first with French's cultivator; next with Perry's scarifier, with scuffle attachment; and lastly, with the same instrument arranged as a subsoil loosener. The yield was fifty-nine tons of beets, which sell readily at ten dollars per ton, but at the present price of fodder are worth more than that for feeding to the stock. The beets were topped in the field, and, after filling the root cellar, about twenty tons were stored in pits in the field. Two pits were also filled with leaves, which were salted and sandwiched with chopped straw, as is often done in Europe, for use as fodder in the spring.

Another piece of the corn ground was sown by Professor Stockbridge with several samples of rye and wheat for experiments. The vegetable garden was twice ploughed, graded and dressed with one hundred and twenty-seven ox-cart loads of barn manure, ploughed again, harrowed and handed over to Professor Stockbridge for cultivation by students as class work.

Good crops were realized of a variety of vegetables, and after these were removed, about twenty cords to the acre was spread on a portion of the land and ploughed in before the ground froze up.

The corn was planted on the slope in the rear of the boarding-house. The land was in grass, and about one-quarter of it received an abundant dressing of barn manure (thirty-five loads of thirty bushels each to the acre) in the fall, which was ploughed in in the spring. The other portion received an equal dressing of like manure, spread on the land after it was ploughed, and harrowed in with the Nishwitz, and afterwards with the Shares' harrow. There was no perceptible difference in the yield of the two pieces. Two cwt. to the acre of different superphosphates was applied in the hill, a portion of each fertilizer being retained by Professor Goessmann for analysis.

The fodder-corn was planted in drills, four feet apart, made a luxuriant growth and was of great benefit in helping out the pasture during the dry weather of July and August. About fifteen acres below the beet-field was seeded down in 1870, with oats, clover and grass seed, but owing to the severe drought the grass seeding was more or less a failure on the greater portion sown. From the 5th to the 11th of June, we ploughed this piece eight inches deep with Holbrook's swivel plough. We then set off two acres of the lightest of the land for turnips, and on the remainder we scattered two tons of superphosphates and harrowed it in, and then sowed four bushels of millet and Hungarian grass, eighty pounds red clover, two bushels herds-grass, two bushels redtop and two bushels of orchard grass. From this piece we harvested eight tons of Hungarian hay, and there appears to be a good stand of grass and clover.

The turnip ground was harrowed June 25th, bushed, marked out in rows, thirty inches apart, and planted, June 26th, with Skirving's purple-top ruta-baga, Carter's Imperial Swede and sweet German turnips. Superphosphates of five different brands were sown along the drills at the rate of four cwt. to the acre. The seed was sown with Holbrook's seed drill, and about half a pound of seed to the acre was used. The crop was twice cultivated, and the plants thinned to eight inches apart in the rows. About the middle of August, the field became infested with lice (*Aphis brassica*), which spread rapidly, and, especially under

shelter of the woods, inflicted severe injury on the crop. Where unmolested by this pest the turnips were excellent, yielding at the rate of twenty-four tons to the acre. The total yield of the piece was, however, only twenty-one tons.

A swamp, lying east of the brook and south of the road from the College to the depot, was thoroughly drained under the direction of Professor Stockbridge, in 1869. It yielded a good crop of corn in 1870, and last spring was ploughed and sown, the 15th of June, with millet and Hungarian grass. Both kinds did equally well, and the piece altogether yielded seven tons of good fodder. In order more thoroughly to subdue the sedge and skunk-cabbage, with which the land was infested, no grass seed was sown with the millet, but the land was again ploughed after the hay was off, and, the first of September, was seeded down with thirty pounds of clover, three pecks of herdsgrass, a bushel of redtop and a bushel of orchard grass. Before sowing the grass seed, we drew and spread on about thirty loads to the acre of compost from the yards.

About two-thirds of an acre south of the new barn received a heavy dressing of manure and was planted with raspberries (Mammoth Cluster), blackberries (Kittatinny), and several kinds of currants and gooseberries. The vines were carefully tended and made a good growth. Before frost set in, the canes were trimmed to four or six in a hill, shortened to four feet and tied up to chestnut stakes. They also received a liberal mulching of strawy manure.

About a third of an acre near the farmhouse was also liberally manured and planted with a variety of strawberries—Wilson's, Jucunda, Dr. Nicaise, Boyden's No. 30, Agriculturist, Lennig's White and President Wilder. Except the Wilder, they have been kept in stools, and all have been well cultivated and have made good growth. They have also been mulched and can scarcely fail to yield a good crop next summer.

One hundred and thirty-three acres have been mown, some once and some twice, and produced one hundred and twenty-five tons of hay of variable quality, the grass having been fully a third less than the average. By cutting early, we got the hay in the best possible condition, and, on the swale alongside the brook, we were cutting a second crop at the time when it has been customary to cut the first. Five hundred loads of compost

from the yards and lanes where the cattle have been yarded were spread on fourteen acres. About eight acres of this were ploughed after haying and reseeded to grass. Four acres near the botanic museum were also ploughed, manured with a ton of superphosphate and reseeded.

About seven acres of land west of the corn were also ploughed after haying, and five acres of it sown with rye. Some two acres below this were also ploughed, but as it was evidently too wet for rye, it is proposed to put in a few rods of drains in the spring, and sow oats and clover. Besides assisting in the cultivation of the crops, harvesting and farm work generally, the students, under the direction of Professor Stockbridge, have planted, tended and harvested the vegetables in the kitchen-garden, straightened the course of the brook before the dormitories and graded the ragged-looking hillocks on its banks. They have also dug up and overturned a multitude of unsightly and useless trees with which the farm was studded, dug and laid drains, and done much other work towards beautifying and permanently improving the farm.

The vaults have been cleaned from time to time, and their contents, well mixed with loam, have been deposited in a large heap, which it is hoped will save the necessity of buying special fertilizers for use in the hill.

An abundance of sand and loam has been provided to receive the contents of the slop-pails, and also to supply the place of that removed from the yards and cellars.

Properly mixed and composted, this will furnish a still larger amount of material for top-dressing and reseeding next fall. A supply of dry earth is provided in a cellar of the College, and a portion is daily scattered in each vault, retaining for manurial purposes the gases which would otherwise escape to poison the atmosphere. Dry earth has also been stored in the new sheds to be used as an absorbent and deodorizer for the poultry houses and hog-pens.

Besides the regular farm work, the teams have done a very large amount of work in expressing and trucking for the dormitories, the plant-house, the laboratory and the horticultural department; in cultivating the nursery, orchards and vineyard; in making and repairing roads; in conducting the water of the reservoir to the laboratory and boarding-houses; in filling in

and wharfing for the new barns and yards, and in hauling two hundred perches of stone from Pelham for the foundation for the new sheds, and for completing the walls at the west end of the main barn.

Income and Expenses.

Below, I submit an account of receipts and expenditures. I regret that the expenses exceed the income, but I do not see how it could be otherwise.

Prices have declined so much during the last year, that cows, which were properly valued at seventy-five dollars each in January, 1871, are now barely worth forty dollars.

Yearlings are worth exactly as much as they were valued at a year ago, and oxen, which have grown from 3,200 to 3,600 pounds, have to be sold at a loss of thirty dollars on their cost in April.

Nor is this the only reason. The college farm is neither better nor worse than the average of farms in the Commonwealth.

By cultivating the best spots, especially with tobacco, which we do not raise, and leaving the rest to take care of itself, and by incessant industry and frugality, a succession of owners have contrived to support themselves and their families.

By the removal of the brush-grown fences, the hideousness of the neglected spots has become glaringly apparent, and the weeds, which were formerly suffered to ripen and spread their seeds in abundance, must now be kept down at a considerable outlay of money and labor.

Gnarled and worthless apple-trees and boulders that have been clipped around for generations, must be removed; bog-holes and gullies offer intolerable impediments to the profitable use of the cultivator, the mowing machine and the reaper, and must be drained and filled up; the roads must be put and kept in irreproachable condition and repair; the stock, a great proportion of which is young animals, must be brought to a high standard of excellence, and be kept groomed, fed and tended with the utmost regularity and completeness; scrupulous attention must be paid to the saving and application of manures, and, in short, every nerve must be strained to improve the condition of the farm, and also to leave as little occasion as possible for

censure to the crowds of visitors, who, from morning till night, are strolling about the premises and examining our proceedings with a critical eye.

Add that much of this work must be done with boys (many of whom are unaccustomed to labor) in the intervals of their studies in the class-room, and it can scarcely be wondered at that we should have failed to improve the farm, to render it available as a means of instruction, and to make it pay in the face of a falling market at one and the same time.

While conscious of an honest desire and a diligent effort to improve the farm and promote the prosperity and usefulness of the College, I fully realize that no business can be satisfactory unless it is profitable. I therefore feel it necessary to say that the money expended has been judiciously and economically applied, and as an investment is paying and will pay a handsome interest.

Even next year the income from the farm will be greatly increased while the expense may be correspondingly lessened.

With much deference, I submit a few suggestions as to the condition, resources and requirements of the farm for 1872.

Much of the mowing land is run out, and all is more or less infested with ox-eye daisy, yellow dock, Canada thistle and wild carrot; while, if a furrow is turned, or even a sod removed, the exposed surface is speedily covered with wild turnip, sorrel and rag-weed, the seeds of which were probably deposited before any of the present generation were born. By top-dressing, and cutting early and often, it is hoped that the grasses will be enabled to crowd the weeds (except the docks, which must be pulled) out of the mowing, and, by constant stirring of the soil, successive crops of weed seeds may be germinated and destroyed. Both these processes need manure, and therefore particular attention should be directed towards economizing and adding to the resources of the farm in this direction. Where land is too far run out to be recovered by top-dressing, or where there is no manure available, an approved method is to plough and sow with oats, harrowing in as much as can be afforded of good superphosphate. This not only ensures a good crop of grain and straw, but it also greatly increases the chance of a good clover crop; and thus it gives the farmer two remu-

nerative crops, and two years to prepare for planting the land, which he will then find in fine condition for his purpose.

The value of superphosphate for corn has already been referred to; it is also useful as furnishing easily digested food to young plants, which, as they grow older, become abundantly able to forage for themselves. It is also of peculiar efficacy in stimulating the growth of turnips, and in pushing them out of reach of the fly.

For these purposes, therefore, I would recommend a moderate appropriation for fertilizers.

A liberal allowance should also be made to buy grain; but this as well as the fertilizers will be reimbursed by the produce of sales of stock and crops. I confidently expect that after next harvest no appropriations will be needed for this end.

It is obviously impossible to employ the students to advantage as teamsters, and it is therefore desirable to keep four good men to work with the teams, and two or three extra hands can be employed to advantage in haying. In case works outside the business of farming are undertaken, suitable appropriations would have to be made. Draining is much needed, and the ground affords singular inducements and facilities for commencing and carrying out a comprehensive and systematic plan of drainage. This would, however, be expensive, and could not be undertaken without your express instructions; but it is in contemplation to put in a few rods of drains in different places where they appear to be urgently necessary, and, I believe, there is an unexpended appropriation of $100 to buy tiles for this purpose.

I have sold the sheep, with the full approval of the executive committee. I believe that I am in no way responsible for their condition, and I have accounted for their price. But the College has now a fine sheep barn and wants some sheep to keep in it. I submit the question of breed, number and quality to your wisdom and liberality.

A horse-power, with a suitable machine for threshing and cleaning grain and cutting feed, &c., should be provided before next fall; or, what would be better still, a small steam-engine to run the machines, and also furnished with suitable apparatus for steaming and cooking food for stock.

An improved cultivator, such as is used in Europe, for the

cultivation of four to eight rows of root crops at one passage, would be a valuable addition to the implements on the farm, and, in connection with the growing interest in sugar-beet culture, would seem to be demanded by the farming interest.

I confidently expect that the receipts from sales of stock and farm produce will be more than twice what they were last year, and they might be more largely increased if it were proper or prudent to sacrifice the reputation of the College for the sake of a temporary gain. It is believed, however, that by culling out and selling to the butcher all inferior animals, a reputation will be gained for those which are kept, of far more value to the institution than the mere advance in price which might be obtained by misrepresentation.

Strawberries, raspberries and blackberries, properly tended and marketed, yield more cash profit than many times their extent in corn and potatoes, and it is proposed to develop this source of income as rapidly as possible. The vegetable garden is now in such a condition that it should yield a considerable income from the sale of vegetables.

Farm Buildings.

In the Seventh Annual Report was given a description of the new barn which was erected in 1869. A severe gale in March, 1870, destroyed the L which was designed for cattle sheds and a sheep barn; standing on the west side of the yard, it was also very useful as a screen from the cold winds of winter. The want of this structure was very much felt during the last year, and additional accommodations were greatly needed for swine, poultry, horses and vehicles. Accordingly, at the request of the executive committee, I prepared a sketch of a building, which, after some modifications, was approved and adopted by the trustees.

Working plans and specifications were then prepared by Mr. Wm. F. Pratt, of Northampton, and a contract for its erection made with Mr. L. N. Granger, of North Hadley, who has performed his work in a very satisfactory manner.

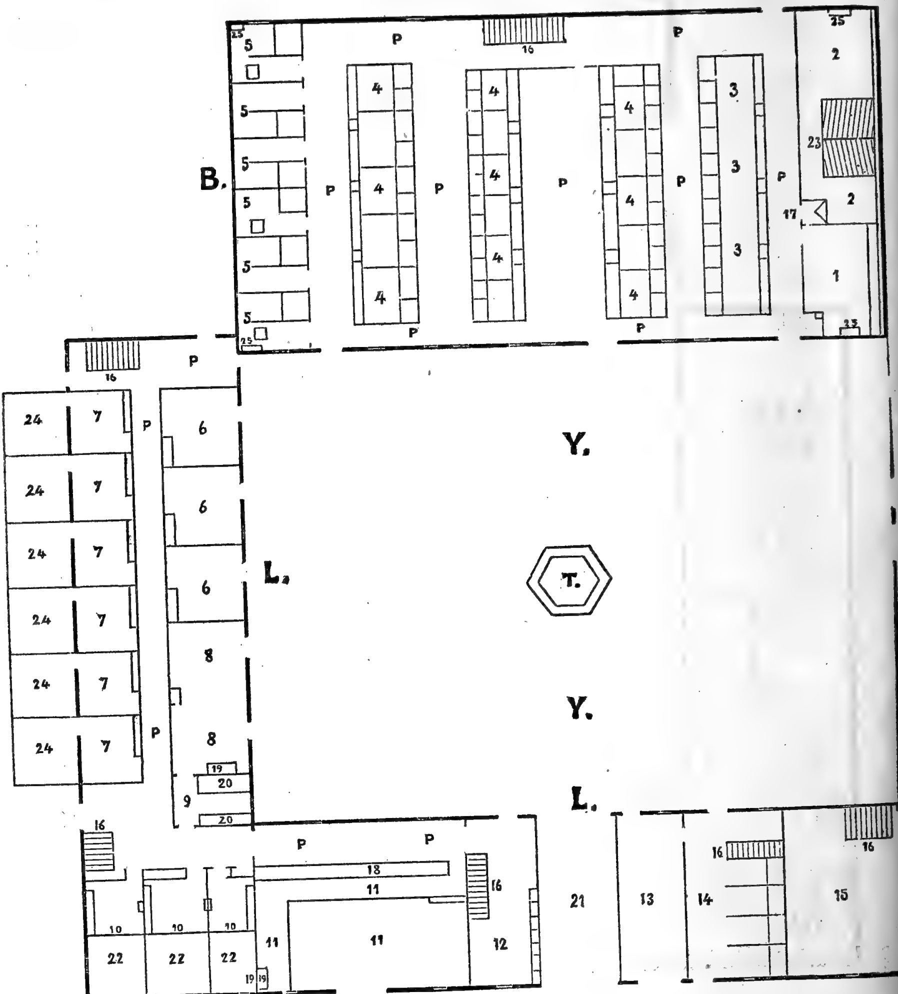
The accompanying plans of the barn and L, were prepared by Mr. F. C. Eldred, of the junior class.

Entering at the north-east door adjoining the barn, visitors pass along a floored walk, five feet wide, running north and

south. On the right or west side of the walk, are six pens for swine, each nine and a half by ten feet, communicating by swinging doors, which the swine readily learn to open, with yards at the back, each ten by ten feet. These pens have plank floors and are furnished with approved feeding troughs, and are made so as to lessen as much as possible the danger of sows overlying their young. On the other side of the walk are three loose boxes, each twelve by twelve feet, for the accommodation of colts, sick animals, or cows about to calve.

A room, twelve by twenty-four feet, is fitted up with a sink, with a very perfect arrangement for supplying and controlling water, a portable boiler capable of holding thirty gallons, a sloping plank floor to carry off blood and slops, and a hoisting apparatus. This room is used to cook and keep food for hogs in, and it is also intended to serve as a slaughter-house. Adjoining this is a small granary, seven by twelve feet. At the end of the walk referred to, is a commodious poultry house, twenty by twenty-six feet, divided into three compartments for the acccommodation of different breeds of fowls. This hennery is lighted by four large windows on the south, and two on the west. About one-half of each of the three divisions is floored with planed and matched boards, and is swept and resanded every morning. The remaining half is filled with gravel, and a few bushels of chaff and hay-seed, removed and replaced every week, furnishes the fowls an opportunity to indulge their instinct for scratching, and conduces greatly to their health and comfort. In each house is a box, two by six feet, and eighteen inches deep, containing coal ashes, sand and sawdust for the fowls to wallow in. An inclined plank, with slats nailed on it at intervals, serves as a ladder from the floor to a shelf above the door. Eighteen inches above this shelf, are the roosting-poles, two inches square; and the droppings which fall on the shelf are removed daily. Nesting-boxes are provided on shelves under the windows in the partition; these boxes are detached for convenience of cleaning. A constant supply of oats is kept in a hopper in each house, and a little corn, wheat and barley is daily mixed with the chaff to stimulate and reward industry. Twice a week we give a mess of scalded meal, in which sulphur has been mixed, and bones and scraps of fresh meat are occasionally pounded up, and eagerly eaten by the fowls. Running

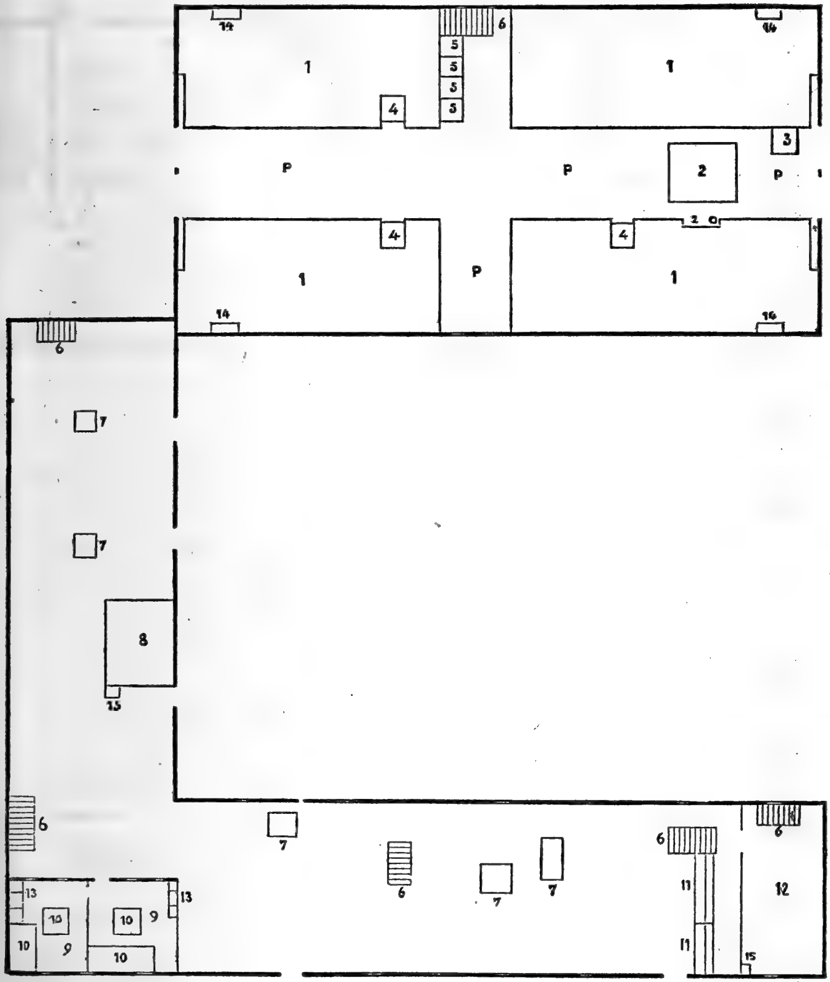
GROUND PLAN OF BARNS. SCALE, THIRTY FEET PER INCH.



EXPLANATIONS.

— — Doors.
—.— Windows.
P. Passage way.
B. Barn.
L. Ell.
Y. Yard.
T. Trough.
1 Calf pen.
2 Root room.
3 Cow stanchions.
4 Cattle stalls.
5 Bull pens.
6 Loose boxes.
7 Hog pens.
8 Slaughter room.
9 Grain room.
10 Hen house.
11 Sheep pen.
12 Tool room.
13 Carriage house.
14 Horse stalls.
15 Shed.
16 Stairs.
17 Privy.
18 Sheep rack.
19 Water cocks.
20 Grain bins.
21 Passage to pasture.
22 Earth for fowls.
23 Screen for roots.
24 Hog yards.
25 Ventilators.

PLAN OF SECOND FLOOR OF BARNS. Scale, thirty feet per inch.



EXPLANATIONS.

—..— Windows.
— — Doors.
P. Passage ways.
1 Bays for hay.
2 Platform scale.
3 Trap for roots.
4 Shoots for hay.
5 Grain bins.
6 Stairs.
7 Trap for hay.
8 Slaughter room.
9 Pigeon room.
10 Gravel boxes.
11 Traps for hay.
12 Office.
13 Breeding boxes.
14 Ventilators.
15 Chimneys.

water is supplied by pipes from the reservoir on the hill. Windows in the partition between the hen-houses and the walk enable visitors to observe the proceedings of the poultry without alarming them by intruding on their premises.

Adjoining the hennery is the sheep barn, twenty-six by thirty-six feet. A raised plank platform, eight feet wide, runs along two sides, and on this are the feed-rack for thirty sheep and a trough supplied with running water. The remainder of the sheep barn consists of an unfloored area into which the droppings are daily swept and covered with litter. A shelf, six by fourteen feet, with roosting-poles over it, serves as a dormitory for turkeys, which, like sheep, thrive best if permitted to go in and out in all weathers. A floored passage-way, six feet wide, runs the whole length of the sheep barn, for convenience in feeding and for the accommodation of visitors. At the end of this passage, is a door leading into the tool-house, which is fitted up with lockers so that each workman can have and be responsible for his own tools. Next, is a covered driveway, twelve feet wide, for the cattle to pass to and from the pastures. In the winter this serves as a shed for the storage of carts and wagons.

East of the driveway is a carriage-house, ten by twenty-six feet; and communicating with this is a four-stall stable, sixteen by twenty-six feet. An open shed, eighteen by twenty-six feet, facing the east, for carts and wagons, completes the range of offices on the ground floor.

On the second floor are lofts for hay and straw, furnished with scuttles at convenient points through which fodder and litter are dropped into the passages below. A pigeon-loft, constructed like the henhouse, with a view to the health and comfort of its inhabitants and the convenience of those who desire to see the birds undisturbed, and to study their character and habits. The east end of this floor is fitted up for the farm superintendent's office.

The barnyard, one hundred by seventy-five feet, is thus sheltered on three sides by the buildings, the remaining or east side being enclosed by a board fence five feet high.

Water from the reservoir on the hill is conveyed by iron pipes to the circular drinking trough in the yard, and to the sheep barn, the hennery and the swill-room. The overflow from the troughs, and also the eaves' water from the north and east

roofs, are collected in a six-inch pipe and discharged on the west of the building at a point where it is proposed to make a small pond for water-fowl. The work about the barns, the milking, cutting roots and fodder, cooking, feeding, cleaning, sweeping, training of bulls, colts, &c., the castration of calves, pigs and lambs, &c., are all performed by students; and, in this connection, it is equally a pleasure and a study to acknowledge that in addition to faithful, intelligent, efficient assistance, I am indebted to my "hired help" for much valuable and interesting information with regard to soils, plants, insects and other subjects with which we are daily concerned. In the summer we commence work at five, and in the winter at six o'clock, A.M., and the barn is all cleaned up and ready for the inspection of visitors before the college exercises commence. The cattle are again let out, the stables cleaned and the cattle put up again, milked and fed between four and six o'clock, P.M., in the winter, and between five and seven o'clock, P.M., in the summer. I divide the work up as much as possible; still there are many applicants for each task, and it is not by any means the most agreeable part of my duty to decide between two boys equally worthy and both needing all they can earn to enable them to pay their way and continue their course.

Stock.

With the exception of one row of grade cows, which all slunk their calves, the cattle have been thrifty and prosperous. There have been no losses, and, except one case of temporary lameness, no sickness among the herd. The abortions were probably the result of confinement in stanchions, on a platform inconveniently short, as none of the other cattle in the barn suffered from this cause, though all were fed and in other respects treated precisely in the same manner. As the cows which aborted were suffered to mix freely with the other cows in the yard, I am confirmed in my opinion that there is not, necessarily, any strong disposition in cows to abort from sympathy. The platform referred to was four feet six inches long; I have had it lengthened eight inches, and the cows which aborted last year show no signs of a recurrence of the disorder. The stock of thoroughbred cattle has been increased by births, as follows: Shorthorns, five bulls, two heifers; Ayrshires, two

bulls, two heifers; Jerseys, one bull, one heifer; Devons, one bull, one heifer. The College has also received a number of gifts of stock, viz.: from Augustus Whitman, Esq., Shorthorn bull "Adonis"; from William Birnie, Esq , Ayrshire bull "Aberdeen"; from H. M. Clark, Esq., Swiss bull "Belmont"; from W. W. Chenery, Esq., Dutch (by some called Holstein) bull "Fourth Highland Chief"; from William Knowlton, Esq., Brittany bull "Upton" and heifer "Pauline," and from O. B. Hadwen, Esq., Jersey bull "Grand Duke." I have also purchased two Ayrshire cows, viz.: "Tulip" (4) and "Beauty" (8), imported in 1855, by Luke Sweetser, Esq. "Beauty" is now nearly eighteen years old, but still hale and hearty. On New Year's day (1872) she presented the College with a heifer calf, by "Colfax" (127), a perfect beauty, for which Mr. Sweetser has offered one hundred dollars.

I have sold three Shorthorn calves (two bulls and a heifer) for one hundred and forty-five dollars; I have, also, sold a Shorthorn heifer, absolutely worthless for milk, to the butcher. Believing that the capacity to yield an abundant supply of good milk is a prime requisite in a cow for New England, and that this property is by no means incompatible with a superior aptitude to lay on flesh when dry, or, indeed, with any of the valuable properties for which the different breeds are prized, we intend to dispose of all those cows which do not come up to a high standard in this respect. In this way it is hoped the cows of the Agricultural College will become celebrated for individual excellence, as well as purity of descent.

The Shorthorn, Devon, Ayrshire and Jersey bulls are all trained to the yoke and are used in place of oxen. This tends to keep them docile, and also evidently increases their sexual vigor and ardor and very much prolongs their usefulness. It is also believed that in a succession of generations the effect for good of using only mature animals will be apparent. The younger bulls are also trained to the yoke and exercised in proportion to their age and strength.

The influence for good of the bulls kept by the College cannot fail to be very great on the cattle of this section. The grade bull has to a great extent disappeared. The necessity of keeping the college herds isolated on account of the foot-and-mouth disease, gave the "scrubs" a temporary opportunity to reassert

themselves; but, since the yards of the College have been opened, the public have shown themselves fully sensible of the superior merits of the pure-bred males.

Chiefly for want of accommodation, the stock of swine have been mainly of one kind—Chester White. The original stock was obtained from Dr. Cutter, in 1870, and we have now a surplus of first-class animals of this valuable breed. With increased accommodations, it is proposed to keep specimens of other breeds—probably the Essex, and perhaps the Berkshire.

For want of suitable premises, no attempts have heretofore been made to keep poultry in a systematic manner, but now that convenient houses have been provided, first-class fowls have been procured of the Game as most nearly representing the original stock, and the Cochin China as specimens of the large Asiatics. It is proposed to add Polands or Houdans as representatives of the crested, non-sitting breeds.

Bronze turkeys, Rouen and Aylesbury ducks, and some six kinds of fancy pigeons enliven the yards and offer opportunities for practical illustration of the principles of breeding, the cost of keeping, the relative profit and the care of different kinds of fowls.

The teams consist of six horses and a yoke of oxen. The latter are being fattened for the butcher, it being intended in the future to make the bulls do the work of oxen. Two pairs are already in use.

The College also owns a beautiful yearling filly of no particular breed, but an excellent representative of the New England horse of all work, and a three-year old jack.

This latter animal grows finely, attracts very general attention by his picturesque appearance, and often enlivens the neighborhood by his melodious voice. He is fairly broken to harness, is thoroughly gentle and free from vice, and, as Mr. Rarey says, "will not offer resistance to any demand which he fully comprehends, if made in a way consistent with the laws of his nature." At the same time all the abuse in the world cannot make him do what he does not want to do.

The following is a list of the thoroughbred animals belonging to the College:—

Shorthorns.—*Males*—Mountain Lad (8,673), Adonis, Sweetbriar, Ingleside, Belted Will, Yarico's Lad. *Females*—Young

Acacia, Yarico 57th, Peachbud 8th, Arabella 10th, Autumn Rose, Aurora 4th, Barre Belle, Emma 3d, Kate Hunnibee, Peachbud.

AYRSHIRES.—*Males*—Colfax (127), Colfax 2d, Aberdeen, Lord Ronald. *Females*—Beauty (8), Tulip 4th (799), Juna (507), Lulie (1,500), Rosa (1,780), Beauty (870), Alice Brand, Beauty 10th.

JERSEYS.—*Males*—Enterprise, Grand Duke. *Females*—Lucy, Rosy, Hattie, Lady Essex.

DEVONS.—*Male*—General Lyon (232). *Females*—Gem 3d (502), Winona 2d (742), Pixie, Enid.

BRITTANIES.—*Male*—Upton. *Female*—Pauline.

SWISS.—*Male*—Belmont.

DUTCH OR HOLSTEIN.—*Male*—4th Highland Chief.

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1871.

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Hon. JOSEPH WHITE, LL.D.,
Lecturer on Civil Polity.

SAMUEL J. PARKER, M. D.,
Lecturer on Fruit Culture.

PROF. EDWARD HITCHCOCK, M. D.,
Lecturer on Comparative Anatomy and Hygiene.

HON. MARSHALL P. WILDER,
Lecturer on Pomology and Floriculture.

A. S. PACKARD, JR., M. D. (STATE ENTOMOLOGIST),
Lecturer on Useful and Injurious Insects.

PROF. EBENEZER S. SNELL, LL.D.,
Lecturer on Physics.

GEORGE B. LORING, M. D.,
Lecturer on Stock Farming.

PROF. RICHARD H. MATHER, M. A.,
Lecturer on Sculpture and German Literature.

GEORGE B. EMERSON, LL.D.,
Lecturer on Arboriculture.

ALONZO BRADLEY, ESQ.,
Lecturer on the Honey Bee.

MARQUIS F. DICKINSON, JR. ESQ.,
Lecturer on Rural Law.

PROF. WILLIAM R. WARE, B. S.,
Lecturer on Architecture.

PROF. GEORGE S. CHENEY,
Teacher of Vocal Music.

WILLARD C. WARE, B. S., GARDENER.

JOHN C. DILLON, FARM SUPERINTENDENT.

Graduates of 1871.

Allen, Gideon Hammond,	Marion.
Bassett, Andrew Lewis,	Amherst.
Birnie, William Perkins,	Springfield.
Bowker, William Henry,	Phillipston.
Caswell, Lilley Brewer,	Fitchburg.
Cowles, Homer Lucian,	Hadley.
Ellsworth, Emory Alexander,	Barre.
Fisher, Jabez Franklin,	Fitchburg.
Fuller, George Elwyn,	Greenfield.
Hawley, Frank Warren,	Hadley.
Herrick, Frederick St. Clair,	Lawrence.
Leonard, George,	New Bedford.
Lyman, Robert Worthington,	Easthampton.
Morse, James Henry,	Salem.
Nichols, Lewis Abel,	Danvers.
Norcross, Arthur Dickinson,	Monson.
Page, Joel Bardwell,	Conway.
Richmond, Samuel Howard,	Taunton.
Smead, Edwin,	Greenfield.
Sparrow, Lewis Addison,	Medway.
Strickland, George Porter,	Amesbury.
Thompson, Edgar Eliab,	Hopkinton.
Tucker, George Homer,	Spring Creek, Pa.
Ware, Willard Carroll,	Salem.
Wheeler, William,	Concord.
Whitney, Frank Le Prelet,	Boston.
Total,	27.

Senior Class.

Bell, Burleigh Cook,	Winchester.
Brett, William Franklin,	North Bridgewater.
Clark, John Wesley,	North Hadley.
Cowles, Frank Colton,	Amherst.
Cutter, John Clarence,	Warren.
Dyer, Edward Norris,	Shrewsbury.
Easterbrook, Isaac Henry,	Boston.
Fiske, Edward Ransom,	Amherst.
Flagg, Charles Otis,	Westminster.
Grover, Richard Baxter,	Amherst.
Holmes, Lemuel Le Baron,	Mattapoisett.
Kimball, Francis Elliot,	Dudley.
Livermore, Russell Wolcott,	Lebanon, Conn.
Mackie, George,	New Bedford.
Maynard, Samuel Taylor,	Northborough.
Morey, Herbert Ellis,	Malden.
Peabody, William Russell,	Boston.
Salisbury, Frank Battelle,	Sherborn.
Shaw, Elliot Dwight,	Chicopee.
Snow, George Henry,	Leominster.
Somers, Frederick Maxwell,	Greenfield.
Thompson, Samuel Clarence,	Southborough.
Wells, Henry,	Stockbridge.
Whitney, William Channing,	Harvard.
Total,	24.

Junior Class.

Clark, William Jared, ...	Cincinnati, Ohio.
Copp, Belton Allyn, ...	Groton, Conn.
Eldred, Frederick Cornelius, ...	Sandwich.
Frisbie, George Benedict, ...	New York City.
Furness, George Abbott, ...	Tarrytown, N. Y.
Johns, Frederick Durfee, ...	St. Charles, Mo.
Lathrop, Joseph Dwight, ...	Northampton.
Leland, Walter Sherman, ...	Sherborn.
Lyman, Asahel Hubert, ...	Westhampton.
Mills, George Westgate, ...	Medford.
Minor, John Bacon, ...	Hartford, Conn.
Penhallow, David Pearce, ...	Portsmouth, N. H.
Renshaw, James Budden, ...	Richmond.
Simpson, Henry Bell, ...	Hudson, N. Y.
Tucker, Charles Edward, ...	Boston.
Warner, Seth Smith, ...	Florence.
Webb, James Henry, ...	New Haven, Conn.
Wellington, Charles, ...	Amherst.
Wood, Frank Warren, ...	Grafton.
Total, ...	19.

Sophomore Class.

Adams, Frank Edgar,	Hadley.
Alexander, Edward Percival,	Greenville, Ill.
Barstow, William Hale,	Haverhill, N. H.
Benedict, John Mitchell,	Bethel, Conn.
Chandler, Edward Phelps,	Westborough.
Curtis, Wolfred Fletcher,	Westminster.
Dickinson, Asa Williams,	Amherst.
Doubleday, Henry Mather,	Brooklyn, N. Y.
Doubleday, William Horace,	" "
French, John Leavitt,	Northampton, N. H.
Gillett, Edward,	Southwick.
Hobbs, John Alden,	Northampton, N. H.
Johns, Arthur Clifford,	St. Charles, Mo.
Libby, Edgar Howard,	Ashland.
Lyman, Henry,	Middlefield, Conn.
Lyman, William,	" "
Millard, David Knox,	Northampton.
Montague, Arthur Huntington,	Granby.
Moody, George Frederick,	Springfield.
Ould, Remus,	Baltimore, Md.
Rowland, Clarence Warner,	West Newton.
Smith, James Metcalf,	Westfield.
Strain, William,	Southwick.
Woodman, Edward Eastman,	Danvers.
Zeller, Bruce Scott,	Hagerstown, Md.
Zeller, Harrie McKeen,	" "
Total,	26.

Freshman Class.

Andreae, George Christ,	New York City.
Ashton, John,	Newton Centre.
Barri, John Atherton,	Cambridgeport.
Bragg, Everett Burt,	Amherst.
Bunker, Madison,	New Bedford.
Callender, Thomas Russell,	Northfield.
Campbell, Fred. George,	Westminster, Vt.
Carruth, Herbert Schaw,	Boston.
Clay, Jabez William,	Westminster, Vt.
Dix, James Quincy,	Boston.
Dodge, George Rufus,	Hamilton.
Ellis, Granville Alden,	New Bedford.
Frothingham, Thomas Goddard,	Boston.
Gibbs, Charles Finney,	Thetford, Vt.
Hague, Henry,	Phenix, R. I.
Harwood, Peter Mirick,	Barre.
Hatch, George Stanley,	Medford.
Holmes, Harry Hawley,	Greenwich, N. Y.
Jackson, Henry Stranahan,	Orange, N. J.
Judkins, Arthur Munroe,	Winchester.
Knapp, Walter Haydn,	Newton Centre.
Lee, Lauren Kellogg,	Shrewsbury.
Merrill, James Cushing,	St. Albans, Vt.
Merrill, Nathaniel Pinkham,	Wilbraham.
Otis, Harry Preston,	Northampton.
Parker, Francis Greenwood,	Brooklyn, N. Y.
Platt, William Davenport,	Baltimore, Md.
Player, Harry Heyward,	Nashville, Tenn.
Reed, Fremont Sumner,	South Weymouth.
Snow, Laban,	Harwich.
Southwick, Andre Arnold,	Mendon.
Stearns, Richard Sprague,	Salem.
Taylor, Ralph Ives,	Great Barrington.
Thomas, John Louis,	Boston.
Vaill, William Henry,	Pelham.
Weeks, Herman Franklin,	Babylon, N. Y.
Winchester, John Frost,	Peabody.
Youchi, Geamon,	Kagoshima, Japan.
Total,	38.

Select Class.

Ariail, Smith,	Stockbridge.
Barber, Strong Hayden,	Windsor, Conn.
Bardwell, Daniel Packer,	Shelburne.
Blankinship, Edwin Augustus,	Marion.
Brown, Clarence Eaton,	Northampton.
Carter, Samuel Marshall,	Berlin.
Clark, Lysander Lyman,	Easthampton.
Clark, William Avery,	Springfield.
Cooke, Charles Montague,	Honolulu,Hawaiian I.
Codina, Gabriel,	Barcelona, Spain.
Cowles, Elliott Addison,	Kellogg, Iowa.
Duncan, George Adams,	Keene, N. H.
Eaton, Harry Ahpeetcha,	Norfolk, Va.
Ely, William Isaac,	Freehold, N. J.
Fisk, Charles Abbott,	Springfield.
King, John Ezra,	Miller's Place, N. Y.
Lyman, Arthur Webster,	Southampton.
Lyons, William Scrugham,	New York City.
Mildeberger, Victor,	" " "
Mitchell, Edward,	Chicago, Ill.
Naito, Saitaro,	Chiyoshiu, Japan.
Newman, Charles Vitallis,	St. Louis, Mo.
Nomura, Ichiskay,	Kagoshima, Japan.
Post, Henry Watross,	Brattleboro, Vt.
Sanderson, Robert Wilson,	Amherst.
Sanger, Herbert Claflin,	Sherborn.
Smith, Frank Stockbridge,	Springfield.
Towne, Frank Augustus,	Keene, N. H.
Watkiss, James Edwin,	Brooklyn, N. Y.
Wright, Augustus Hunt,	Boston.
Yamao, Tenataro,	Yeddo, Japan.
Zeller, William Melville,	Hagerstown, Md.
Total,	32.

Summary.

Graduates of 1871,	27
Seniors,	24
Juniors,	19
Sophomores,	26
Freshmen,	38
Select,	32
Total,	166

COURSE OF STUDY AND INSTRUCTION.

Freshman Year.

First Term.—Recitations in Human Anatomy and Physiology; Chemical Physics; and Commercial Arithmetic and Book-keeping. Lectures on Agriculture: *first*, its importance as an Art, and its relations to other pursuits; *secondly*, as a Profession, and the education it requires; and *thirdly*, of Soils, their origin, varieties and composition. Lectures on the properties of Matter and the nature and effect of the forces, Heat, Light, and Electricity. Lectures on the Laws of Health. Instruction in Elocution; and in Penmanship and Orthography, for such as are deficient in these branches. Military Drill; Infantry Tactics; School of the Soldier.

Second Term.—Recitations in Chemistry; and Algebra; Lectures on Agriculture; Improvement of Soils by chemical and mechanical means; Drainage; Irrigation; Tillage; Implements for, and methods of stirring and pulverizing the soil and subsoil. Lectures on the Chemistry of the Non-metallic Elements; the principles of Chemical Philosophy; the most important Metals, and their uses in the Arts. Instruction in Elocution; Vocal Music; and English Composition. Military Drill; Infantry Tactics; School of the Company, and Manual of Arms.

Third Term.—Recitations in Algebra and Geometry; and French. Lectures on Agriculture; Sterility of Soils, its causes and remedies; Rotation of Crops. Lectures on Organic Chemistry; Instruction in the Laboratory in Analytical Chemistry. Instruction in Elocution, and Reading. Military Drill; Infantry Tactics; Schools of the Company and Battalion.

Sophomore Year.

First Term.—Recitations in French, with written exercises; Zoölogy; Geometry and Conic Sections. Lectures on Agriculture; Mineral Fertilizers: Organic Fertilizers; Animal Manure, its origin, varieties, value, and treatment; Waste of Fertilizers. Absorbents of liquid Manures: Composts; Application of Fertilizers. Lectures on Agricultural Chemistry; Instructions in the Laboratory in Practical Chemistry. Exercises in Declamation; and French Translation. Military Drill: Infantry Tactics; Manual of the Bayonet, and instruction in duty as Skirmishers.

Second Term.—Recitations in French; Logarithms, Plane and Spherical Trigonometry, and Measurement of Lines, Surfaces and Volumes. Lectures on Agriculture; Economy in the treatment and use of Soils, Manures, Crops, Teams, Laborers, Live Stock, Implements, Fences and Buildings. Lectures

on Quantitative Analysis, and Practice in the Chemical Laboratory. Exercises in Declamation; and Vocal Music. Military Drill: Infantry Tactics; Bayonet Exercise.

Third Term.—Recitations in History; and Surveying, with Practical Land Surveying, Plotting and Geometrical Drawing. Lectures on Agriculture; Farm Management; Selection of Lands. Division into mowing, arable, pasture and woodland; Roads; Fences; Buildings; System to be adopted; Plans for each year; Cultivation and use of the various crops; Sources of profit in General Farming; Special Farming. Exercises in Reading; and Practice in Writing Sentences on the Blackboard. Military Drill: Infantry Tactics; Skirmish and Battalion Drill; Guard Duty; and Forms of Parade and Review.

Junior Year.

First Term.—Recitations in German; Mechanics of Solids and Liquids; and Physical Geography. Lectures on Agriculture; Market Gardening, including Small Fruits. Lectures on Useful and Injurious Insects. Instruction in Practical Levelling, and Topographical Drawing. Exercises in Reading Shakespeare. Military Drill; Artillery Tactics; School of the Piece.

Second Term.—Recitations in Mechanics of Air and Steam; Light; Heat; Electricity; German; and Structural Botany. Lectures on the Construction and Management of Plant-houses, and the Cultivation of Plants under Glass. Lectures on Mechanics and Statical Electricity. Instruction in Free-hand Drawing; Perspective; and Shades and Shadows. Exercises in Agricultural Discussion; and Vocal Music. Military Drill: Artillery and Cavalry Tactics; Manual of the Sabre; School of the Trooper Dismounted; Instruction in Heavy Artillery Tactics and Gunnery.

Third Term.—Recitations in Astronomy; Systematic Botany; and German. Lectures on Milch Cows and Dairy Farming. Lectures on Stock Farming, and the Breeding of Domestic Animals. Lectures on Physics; and Comparative Anatomy. Exercises in Debate. Military Drill: Artillery Tactics; School of the Section; Infantry Tactics; Battalion Drill.

Senior Year.

First Term.—Recitations in Mental Science; Rhetoric; and Civil Engineering. Lectures on English Literature. Lectures on the Cultivation of Fruits and Flowers. Instruction in Mechanical and Architectural Drawing; and in preparing Working Plans and Specifications. Exercises in Original Declamation. Military Drill: Cavalry, Artillery and Infantry Tactics; Duty as Drill Masters and Officers in Infantry and Artillery Drill; Theoretical Instruction in Cavalry Tactics, and the organization and uses of Cavalry.

Second Term.—Recitations in Moral Science; Political Science and Economy; and English Literature. Lectures on Rural Law, including the Rights and Obligations of Landholders. Lectures on Arboriculture; the planting and care of Trees for the production of Fuel, Timber, Fruit, or for other purposes. Lectures on Military History; Military Law and Courts Martial. Exercises in Original Declamation. Military Drill: Cavalry Tactics; Sabre Exercise.

Third Term.—Recitations in Landscape Gardening; Geology and General Reviews. Lectures on Diseases of Domestic Animals. Lectures on Architecture. Lectures on Mineralogy and Geology; Meteorology and Civil Polity. Exercises in Original Declamation. Military Drill: Target Practice; Sword Play; and General Drill.

Practice in the various operations of the Farm and Garden through the course.

Select Course.

Those who do not intend to pursue the full course, may select from the studies of the first, second or third terms of any year in the curriculum, such instruction as they choose, provided they are qualified for it.

CALENDAR FOR 1872.

The second term of the collegiate year begins January 11, and continues till April 10.

The third term begins April 18, and continues till July 19.

The first term begins August 29, and continues till the Wednesday before Thanksgiving.

There is an Examination of candidates for admission to the College, at the Botanic Museum, at 9 A. M., Tuesday, July 16, and also on Thursday, August 29.

The annual Public Examination and the Prize Declamations take place Monday, July 15.

The exercises of Class Day and the Address before the Literary Societies take place on Tuesday, July 16. The exercises of Graduation Day, July 19.

ADMISSION.

Candidates for admission to the Freshman Class are examined, in writing, upon the following subjects: English Grammar, Geography, Arithmetic, and the History of the United States.

Candidates for higher standing are examined as above, and also in the studies gone over by the class to which they may desire admission.

No one can be admitted to the College until he is fifteen years of age, and every student is required to furnish a certificate of good character from his late pastor or teacher, and to give security for the prompt payment of term bills. Tuition and room-rent must be paid in advance at the beginning of each term; and bills for board, fuel, and washing at the end of every term.

The regular examinations for admission are held at the Botanic Museum at 9 o'clock A. M., on Tuesday, July 16, and on Thurday, August 29; but candidates may be examined and admitted at any other time in the year.

Further information may be obtained from President W. S. Clark, Amherst, Mass.

EXPENSES.

Tuition,	$18 00 per term.
Room-rent,	5 00 "
Incidental expenses,	1 00 "
Board,	3 50 per week.
Washing,	50 per dozen.
Expenses of Chemical Laboratory to students of Practical Chemistry,	5 00 per term.
Public and private damages, including value of chemical apparatus injured or destroyed,	at cost.
Annual expenses, including books,	$250 00 to $300 00

REMARKS.

The full course of study occupies four years, and those who complete it receive the degree of Bachelor of Science.

The instruction in the languages is intended to qualify the graduates to write and speak English with correctness and effect, and to translate French and German with facility. The scientific course is extensive and thorough, and as practical as possible. Every student has an opportunity of becoming a good chemist, a skilful veterinarian, and a civil engineer. At the same time every science is taught with constant reference to its application to agriculture and the wants of the farmer.

The instruction in agriculture and horticulture includes every branch of farming and gardening which is practiced in Massachusetts, and is both theoretical and practical.

Each topic is discussed thoroughly in the lecture-room, and again in the plant-house or the field, where every student is obliged to labor. The amount of required work, however, is limited to six hours per week, in order that it may not interfere with study. Students are allowed to do additional

work, provided they maintain the necessary rank as scholars. All labor is paid at the rate of ten to twenty cents per hour, according to its value. There is no provision for indigent students, beyond the opportunity to do such work as may offer about the college and farm buildings, or in the field, and it is hardly possible to earn more than from $50 to $100 per annum, besides performing other duties. So far as is consistent with circumstances, students will be permitted to select such varieties of labor as they may, for special reasons, desire to engage in.

Those who pursue a select course attend recitations and lectures with the regular classes; but persons properly qualified, and desiring special instruction in chemistry, civil engineering, veterinary science, agriculture or horticulture, may make private arrangements with the officers having charge of these departments.

An expenditure of from $10 to $50 is necessary to provide furniture, which may be purchased at reasonable rates, either new or second-hand.

On Sundays, students are expected to attend the chapel service and Bible-class, which are conducted by the professor of moral science. While the Bible is made the basis of all religious instruction, everything of a denominational character is as far as practicable avoided.

Students may, upon the written request of their parents or guardians, be excused from these exercises to attend services in one of the churches of the town.

REGULATIONS.

1. Students are specially forbidden to combine together for the purpose of absenting themselves from any required exercise, or violating any known regulation of the College.

2. The roll shall be called five minutes after the ringing of the bell for each exercise of the College by the officer in charge, unless a monitor be employed, and students who do not answer to their names shall be marked absent; provided that any student coming in after his name has been called shall be marked tardy. Two tardinesses shall be reckoned as one absence.

Students attending exercises in the Botanic Museum will be allowed ten minutes between the ringing of the bell and roll-call.

3. Absence from a single exercise may be allowed or excused by the officer in charge of the same; but permission to be absent from several exercises must be obtained from the general excusing officer, or from the president. In such cases a certificate of excuse will be furnished by the excusing officer, which shall state the precise time for which the permission of absence is granted, and shall be a satisfactory reason for absence from all exercises occurring within the time specified.

All excuses must be promptly rendered, and officers will not be expected to receive them, unless offered within one week from the occurrence of the absences, provided there has been an opportunity for presenting them.

4. Whenever the aggregate number of unexcused absences in all departments reaches five, the student so delinquent shall be seen by the president in reference to his conduct. When the number of such absences becomes eight, the president shall inform the parent or guardian of the student of the fact; and when ten such delinquencies are justly recorded against any student, his connection with the College shall cease.

At the end of each term the faculty may, at their discretion, cancel a part or all of the unexcused absences recorded against any student.

5. Students are forbidden to absent themselves without excuse from the regular examinations; to give up any study without permission from the president; or to remove from one room to another without authority from the officer in charge of the dormitory buildings.

6. The record of deportment, scholarship and attendance will be carefully kept, and whenever the average rank of a student for any term falls below fifty, he will not be allowed to remain longer a member of College, except by special vote of the faculty.

7. Students are required to abstain from everything injurious to the buildings and other property of the College, and in all respects to be gentlemen.

BOOKS, APPARATUS, AND SPECIMENS IN NATURAL HISTORY.

The library of the College contains about one thousand volumes. Among them are several valuable sets of cyclopædias, magazines and newspapers, reports of Agricultural Societies and State Boards of Agriculture, and many standard works on Agriculture and Horticulture. There are also many excellent works of reference in Chemistry, Botany, Surveying and Drawing. The larger part of the books have been presented to the Institution by private individuals.

The State Cabinet of Specimens, illustrating the Geology and Natural History of Massachusetts, has been removed from Boston to the College, and is of much value for purposes of instruction.

The Knowlton Herbarium contains more than fifteen thousand species of named botanical specimens, besides a large number of duplicates. The Botanic Museum is supplied with many interesting and useful specimens of woods, seeds, and fruit models. There is, also, a very extensive set of diagrams, illustrating structural and systematic Botany.

About one thousand species and varieties of plants are cultivated in the Durfee Plant-house, which affords much pleasure and information to the students of both colleges.

The very extensive, and in many respects unsurpassed, collections in Geology, Mineralogy, Natural History and Ethnology, belonging to Amherst College, are accessible to members of the Agricultural College.

The Chemical, Engineering and Military departments of the Agricultural College are well furnished.

The Armory contains two brass pieces of artillery, fifty sabres, and one hundred and fifty breech-loading rifles.

FINANCIAL STATEMENT,

JANUARY 1ST, 1872.

REAL ESTATE.

College Farm and Quarry,	$37,500 00
South College,	36,000 00
North College,	36,000 00
College Hall,	30,000 00
South Boarding-House,	8,000 00
North Boarding-House,	8,000 00
Durfee Plant-House,	12,000 00
Botanic Museum,	5,000 00
South Barn,	14,500 00
Farm House,	4,000 00
Four Dwellings and Barns, purchased with the estate,	10,000 00
Total Real Estate,	$201,000 00

FARM STATEMENT.

Value of Live Stock,	$9,255 00
of Vehicles and Implements,	2,771 00
of Produce on hand,	3,613 00
	$15,639 00

Total credits of Farm, including property inventoried, Jan. 1, 1871, credit for labor performed in grading, &c., and receipts from sales of live stock and produce,	$11,116 46
Total debits of Farm, including property inventoried, Jan. 1, 1871, and all expenditures for live stock, labor, implements, repairs, seeds, fertilizers, &c.,	$16,387 38

FUND FOR MAINTENANCE OF COLLEGE,

IN CHARGE OF THE STATE TREASURER.

The total amount received from the sale of 360,000 acres of land given to Massachusetts, for the endowment of one or more colleges for the promotion of education in agriculture and the mechanic arts, is	$236,307 40
Of this amount, in accordance with the Act of Congress, was expended for a farm, ...	29,778 40

The sum of $208,464.65 which was received for $\frac{9}{10}$ of the land scrip was constituted, in 1863, a perpetual fund for the promotion of education in agriculture and the mechanic arts. In 1871, this fund was increased by the legislature to $350,000.

The investments of this fund, made by the State Treasurer, are as follows:

United States bonds, 5-20's, interest 6 per cent. gold, . .	$50,500 00
" " " 10-40's, " 5 " " . .	30,000 00
Massachusetts bonds, 5 per cent. gold, ...	24,000 00
" " 6 per cent. currency, ...	3,000 00
City of Salem bonds, 6 " "	55,000 00
City of Lynn bonds, 6 " "	25,000 00
Town of Milford bonds, 6 " "	14,200 00
Town of Plymouth note, 6 " "	6,724 65
Brighton note, 6½ per cent., ...	10,000 00
West Roxbury note, 7 per cent., ...	80,000 00
County of Hampden note, 6½ per cent., ...	50,000 00
Cash in Treasury, ...	1,575 35
Total Fund, ...	$350,000 00
Annual Income of Fund at 6 per cent., ...	$21,000 00

Two-thirds of this is by law paid to the treasurer of the College, and one-third to the treasurer of the Institute of Technology.

Income of College from Fund, ...	$14,000 00
By the conditions of the gift, none of the income of the fund derived from the sale of land scrip can be used for the erection or repair of buildings.	
The Hills Fund of $10,000 for the maintenance of the Botanic Garden is in charge of the College treasurer, and at present yields an income of	500 00
Total Income from Funds, ...	$14,500 00

To this sum should be added the receipts of tuition and room-rent, amounting to $72 per annum for each scholar, and the receipts from the sale of the products of the farm and garden.

DR. MASSACHUSETTS AGRICULTURAL COLLEGE *in account with* NATHAN DURFEE, *Treasurer.* CR.

1871.			1871.		
Jan. 1,	To Cash balance on hand,	$2,251 91		By Contingent expenses,	$10,672 51
30,	Income of Hills Fund,	500 00		Salaries,	16,461 67
30,	Income from State Treasurer,	5,351 02		Farm account—balance,	5,704 82
June 28,	Income from State Treasurer,	3,076 49		Students' board account,	7,032 16
28,	State appropriation,	50,000 00		Note and interest paid,	11,385 00
Nov. 10,	Income from State Treasurer,	3,936 71		Building account,	4,000 00
	Receipts from term bills,	11,785 12		Indebtedness of 1870,	3,000 00
				Horticultural department,	771 18
				Chemical department,	878 53
				Balance Jan. 1, 1872,	16,995 38
		$76,901 25			$76,901 25

Respectfully submitted,

NATHAN DURFEE, *Treasurer.*

I have examined the Treasurer's accounts, and find them correctly stated and accompanied by the proper vouchers.

HENRY COLT, *Auditor.*

GIFTS.

The following persons have manifested their interest in the College, during the year, by donations, namely: —

William Knowlton, Esq., of Upton, the Brittany bull, Upton, and the heifer, Pauline, from the importation of Hon. C. L. Flint; also, $50, for the purchase of books for the library of the Edward Everett Literary Society.

Henry M. Clark, Esq., of Belmont, the Swiss bull, Belmont, from stock imported by him.

Winthrop W. Chenery, Esq., of Belmont, the Dutch or Holstein bull, 4th Highland Chief, from stock imported by him from Holland.

Hon. Albert Fearing, of Boston, $100, for the purchase of books for the Edward Everett Literary Society.

Rev. Charles C. Sewall, of Medfield, eight volumes of Massachusetts Agricultural Repository.

Col. Eliphalet Stone, of Dedham, $20 for books, and two photographs of glaciers in Greenland.

Hon. Marshall P. Wilder, of Boston, two hundred President Wilder strawberry plants.

Hon. Richard Goodman, of Lenox, $50, for a student.

Hon. C. L. Flint, of Boston, one hundred copies of Report of Massachusetts Board of Agriculture.

Hon. William B. Washburn, of Greenfield, six volumes Report on the Paris Exposition, and other public documents; also, twenty-five copies United States Report on Agriculture, for students.

Hon. Henry Lane, of Cornwall, Vt., seed of the American Improved sugar beet, which he advises to raise for fodder.

Professor Asa Gray, of Cambridge, valuable plants.

Rev. G. P. Claflin, of Sierra Leone, seeds.

Leverett Saltonstall, Esq., of Newton, three volumes Agassiz's Contributions to Natural History.

Messrs. G. and C. Merriam, of Springfield, Webster's Unabridged Dictionary, superbly bound.

R. Cummings, Esq., of Newport, Vt., one copy of Vermont Farmer for 1872.

Alonzo Bradley, Esq., of Lee, a hive of bees.

Augustus Whitman, Esq., of Fitchburg, the Shorthorn bull, Adonis.

William Birnie, Esq., of Springfield, the Ayrshire bull, Aberdeen.

O. B. Hadwen, Esq., of Worcester, the Jersey bull, Grand Duke.

Hon. Horace Capron, of Washington, D. C., ten copies each of United States Bi-monthly and Annual Agricultural Reports.

William Saunders, Esq., of Washington, D. C., sixty-seven species of rare plants and box of fruit.

Messrs. Ellwanger and Barry, of Rochester, N. Y., sixty varieties of apples and pears, to illustrate lectures on Fruit Culture.

Pleasant Valley Wine Co., of Hammondsport, N. Y., one case of wine and twelve boxes of grapes.

Samuel J. Parker, M. D., of Ithaca, N. Y., one box of apples, pears, grapes, and nuts, to illustrate his lectures on Fruit Culture; also, several samples of cans for preserving fruit.

The following newspapers were sent gratis, during 1871, by the publishers, viz.: American Agriculturist, Amherst Record, Boston Cultivator, California Farmer, Hearth and Home, Massachusetts Ploughman, New England Farmer, New England Homestead, Prairie Farmer, Rural New Yorker, and the Vermont Farmer; also, Publications of Peabody Academy of Sciences, Essex Institute, Museum of Comparative Zoölogy, Smithsonian Institution, Bowdoin Scientific Review, and Torrey Botanical Club.

Agricultural Societies have paid the tuition and expenses of students of their own selection as follows:—

Berkshire,	$54 00
Essex,	100 00
Franklin,	51 00
Hampshire,	51 00
Hampshire, Franklin and Hampden,	54 00
Hingham,	150 00
Housatonic,	54 00
Mass. Society for Promotion of Agriculture,	216 00
Middlesex South,	54 00
Norfolk,	54 00
Plymouth,	108 00
Worcester,	54 00
" North,	54 00
" South-East,	51 00
" West,	54 00

A. L. Bassett, B. S., of Amherst, a collection of one hundred and thirty-three species of native woods, viz.:—

Abies alba.
" balsamifera.
" Canadensis.
" nigra.
Acer dasycarpum.
" Pennsylvanicum.
Acer rubrum.
" saccharinum.
" spicatum.
Æsculus glabra.
" Hippocastanum.
Alnus incana.

Alnus serrulata.
Amelanchier Canadensis.
" Canadensis, var. Botryapium.
Ampelopsis quinquefolia.
Andromeda ligustrina.
Azalea nudiflora.
" viscosa.
Benzoin odoriferum.
Berberis vulgaris.
Betula alba.
" excelsa.
" lenta.
" papyrifera.
Carpinus Americana.
Carya alba.
" amara.
Cassandra calyculata.
Castanea vesca.
Ceanothus Americanus.
Celastrus scandens.
Cephalanthus occidentalis.
Clethra alnifolia.
Comptonia asplenifolia.
Cornus alternifolia.
" florida.
" sericea.
" stolonifera.
Corylus Americana.
" rostrata.
Cratægus coccinea.
" tomentosa.
Cydonia vulgaris.
Dirca palustris.
Fagus ferruginea.
Fraxinus acuminata.
" pubescens.
" sambucifolia.
Gaylussacia frondosa.
" resinosa.
Hamamelis Virginica.
Ilex glabra.
" lævigata.
" opaca.
" verticillata.
Juglans cinerea.
Juniperus communis.
" Virginiana.
Kalmia augustifolia.
" glauca.
" latifolia.
Larix Americana.
Ledum latifolium.
Liriodendron Tulipifera.
Lonicera ciliata.
" cœrulea.
" parviflora.
Magnolia acuminata.
Morus alba.
Myrica cerifera.
" Gale.
Nemopanthus Canadensis.
Nyssa multiflora.
Ostrya Virginica.
Pinus rigida.
" Strobus.
Platanus occidentalis.
Populus alba.
" balsamifera.
" candicans.
" dilitata.
" grandidentata.
" monilifera.
" tremuloides.
Prunus Americana.
" maritima.
" Pennsylvanica.
" serotina.
" Virginiana.
Pyrus Americana.
" arbutifolia.
" Malus.
Quercus alba.
" bicolor.
" ilicifolia.
" obtusifolia.
" Prinus.
" Prinus, var. monticola.
" rubra, var. tinctoria.
Rhamnus alnifolius.
" catharticus.
Rhododendron Lapponicum.
Rhodora Canadensis.
Rhus copallina.
" glabra.
" Toxicodendron.

Rhus typhina.
" venenata.
Robinia Pseudacacia.
Sambucus Canadensis.
" pubens.
Sassafras officinale.
Spiræa salicifolia.
" tomentosa.
Staphylea trifolia.
Taxus baccata, var. Canadensis.
Tilia Americana.
Ulmus Americana.
" fulva.

Vaccinium corymbosum.
" Pennsylvanicum.
" stamineum.
" uliginosum.
" vacillans.
" Vitis-idœa.
Viburnum acerifolium.
" dentatum.
" lantanoides.
" Lentago.
" nudum.
" Opulus.
Xanthoxylum Americanum.

14

SUMMARY OF METEOROLOGICAL OBSERVATIONS

For the Year 1871,

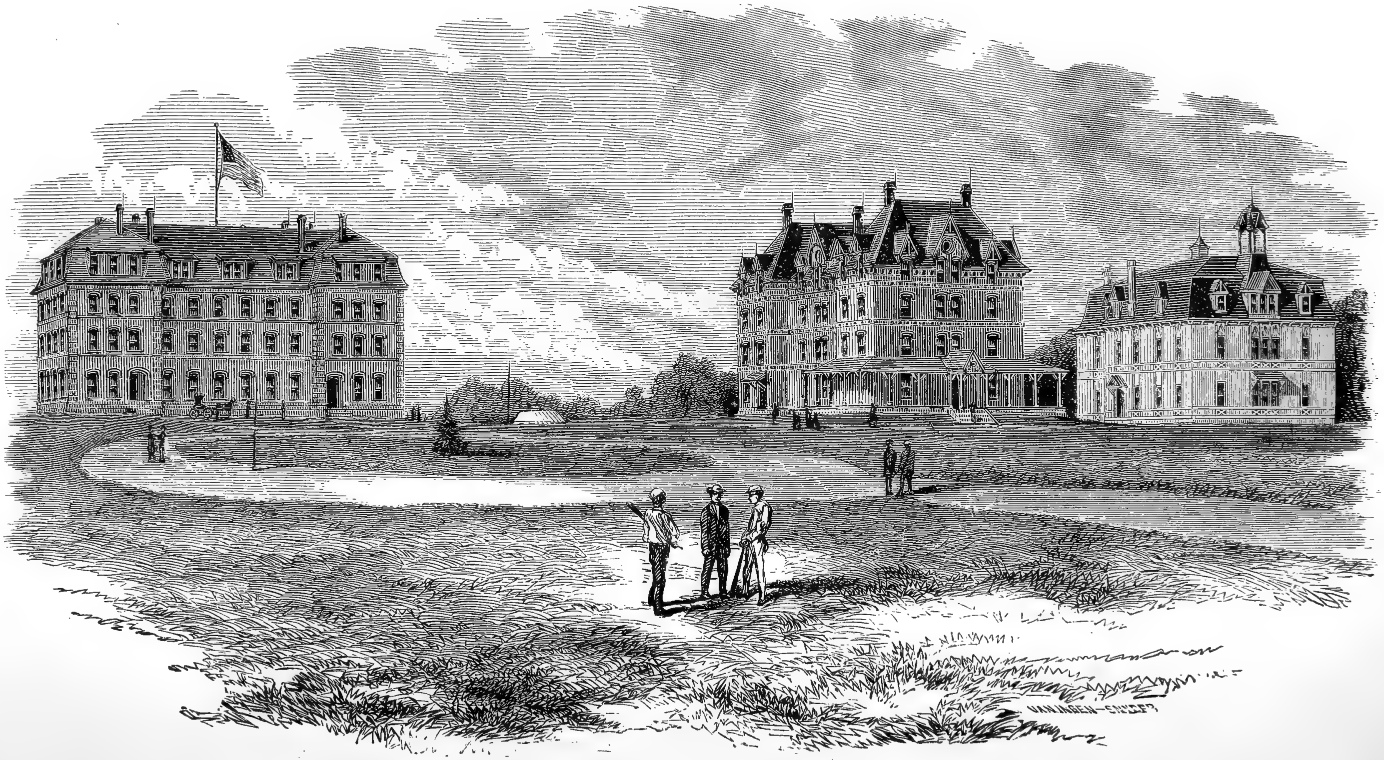
TAKEN AT AMHERST, MASS.,

By Professor E. S. SNELL, LL. D.

Latitude 42° 22′ 17″. Longitude 72° 34′ 30″. Elevation above the sea level, 267 feet.

SUMMARY OF METEOROLOGICAL OBSERVATIONS FOR 1871.

MONTHS.	THERMOMETER IN THE OPEN AIR.			RAIN AND SNOW.		CLOUDS.	WINDS. PER CENT. OF TIME AND FORCE.				BAROMETER. BAROMETER HEIGHT REDUCED TO FREEZING POINT.			FORCE OR PRESSURE OF VAPOR, IN INCHES.			RELATIVE HUMIDITY OR FRACTION OF SATURATION.		
	Maximum.	Minimum.	Mean.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Mean per cent. of sky.	Northwest.	Southwest.	Southeast.	Northeast.	Maximum.	Minimum.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
January, . .	50.0	-5 5	23.27	1.960	12.5	61	52	14	17	17	30 428	29.280	29.889	.253	.017	.106	100	39	74
February, . .	50.6	-9.5	25.95	2.907	12.0	49	55	9	24	12	30.288	28.869	29.718	.298	.023	.111	100	47	71
March, . .	55.5	24 8	40.53	3 988	1.0	56	42	16	31	11	30 105	29.163	29.691	.405	.038	.175	96	16	68
April, . . .	74.8	27.0	48.00	3.087	3.0	54	47	10	27	16	30.035	29.285	29.551	.410	.057	.214	100	20	64
May, . . .	92.8	41.0	57.84	3.815	-	37	44	10	30	16	30.029	29.184	29.659	.745	.085	.304	95	15	62
June, . . .	88.2	51.8	65 38	6.575	-	46	47	12	25	6	29.906	29.219	29.629	.691	.277	.462	98	35	74
July, . . .	85.6	54.0	69.18	3.523	-	51	42	17	34	7	29.946	29.324	29.645	.725	.255	.423	98	32	76
August, . .	85.0	50.0	68.87	6.453	-	43	36	18	40	6	30.120	29.329	29 703	.924	.295	.568	100	33	80
September, . .	78.0	32.0	52 84	1.302	-	29	41	15	25	19	30.156	29 422	29.800	.545	.151	.322	99	30	74
October, . .	73.1	24.3	50.95	6 089	-	46	30	31	24	15	30.234	29.365	29.795	.644	.119	.290	100	33	75
November, . .	62.0	7 0	34.03	3.507	3 0	49	66	9	13	12	30.150	29.046	29.667	.427	.031	.152	100	39	72
December, . .	43.3	-6.5	24.62	2.668	12.0	52	66	14	16	4	30.323	29.056	29.718	.270	.022	.112	100	29	74
YEAR, . .	92.8	-9.5	46.79	45.874	43.5	49	48	15	25	12	30.428	28 869	29.705	.924	.017	.270	100	15	72



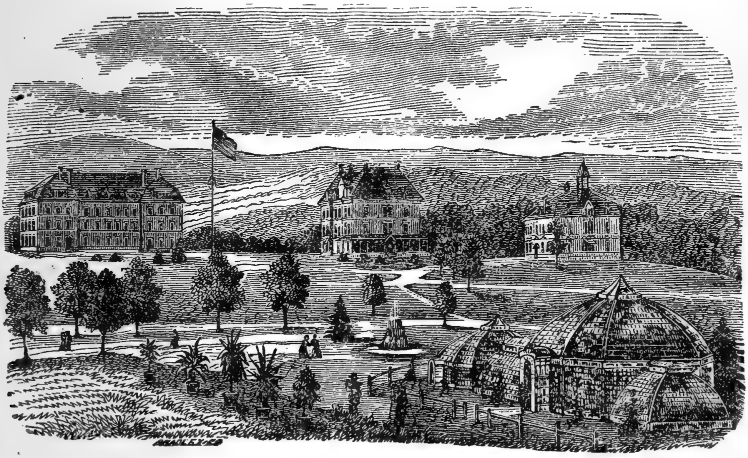
MASSACHUSETTS AGRICULTURAL COLLEGE.

SENATE...... ......No. 75.

TENTH ANNUAL REPORT

OF THE

Massachusetts Agricultural College.



JANUARY, 1873.

BOSTON:
WRIGHT & POTTER, STATE PRINTERS,
No. 19 PROVINCE STREET
1873.

INDEX.

Commonwealth of Massachusetts.

EXECUTIVE DEPARTMENT, BOSTON, January 31, 1873.

To the Honorable Senate and House of Representatives.

I have the honor to transmit herewith, for the information of the General Court, and such disposition as may appear expedient, the Tenth Annual Report of the Trustees of the Massachusetts Agricultural College, with accompanying documents.

W. B. WASHBURN.

Commonwealth of Massachusetts.

AMHERST, January 30, 1873.

To His Excellency WILLIAM B. WASHBURN.

SIR:—I have the honor herewith to present to your Excellency and the Honorable Council, the Tenth Annual Report of the Massachusetts Agricultural College.

Very respectfully, your obedient servant,

W. S. CLARK, *President.*

ANNUAL REPORT.

To His Excellency the Governor and the Honorable Council.

The Trustees of the Massachusetts Agricultural College respectfully offer the following Report concerning their operations during the year 1872, and the present condition and prospects of the institution under their charge:—

Finances.

As no grant was received from the last legislature, no additional buildings have been erected and but few improvements attempted since the last annual report. Nevertheless, with the money in the treasury at the beginning of the year, the income from the endowment fund and the receipts from term-bills and sales of farm and garden produce, all debts have been cancelled and the current expenses paid, while a small balance remains on hand, as appears in the report of the Treasurer, and the financial statement herewith transmitted. With the exception of a few special gifts from the Board of Trustees, no funds have been donated by individuals for permanent prizes or scholarships, for the aid of indigent students, for the purchase of books or apparatus, for the improvement of the farm, for agricultural experiments, for the planting and keeping of the botanic garden, for the increase of the plant-houses, for the endowment of professorships, or the erection of buildings, although these important and most deserving objects have been repeatedly and urgently presented to the notice of the wealthy friends of the College.

Society Scholarships.

Some of the agricultural societies have continued the annual scholarships heretofore maintained by them, but many have

failed to make the usual appropriations, notwithstanding earnest applications in several cases from worthy young men needing such assistance. The failure to keep up this most important connection with the College seems to have been the result either of indifference to the subject of agricultural education, or of a feeling that as there were students enough in attendance no further effort was necessary. The Massachusetts Society for Promoting Agriculture has, however, with wise liberality, maintained four scholarships, the recipients of which are required to be good students, and to have the intention of becoming farmers or gardeners after graduation. It is exceedingly desirable that each agricultural society in the Commonwealth should keep itself constantly interested in the objects of the College, and select from its own limits, by a thorough competitive examination, one or more students, who should receive its bounty and be its representatives at the State institution for the training of farmers, and who, having finished their course with honor, should return home to be most useful helpers in the great cause of agricultural improvement.

Examination for Admission.

The real value of the work done by the College must depend largely upon the natural ability and thorough preparation of the young men who present themselves for education, and while the number who can be accommodated in its rooms is so limited as at present, a judicious selection of the most promising candidates is particularly necessary. There is a very natural desire on the part of the excellent officers in charge of the several departments of instruction to raise the standard of attainments for admission to the highest practicable point. It has, however, been thought by the Trustees that the College course should begin at a point attainable by the sons of farmers in the common schools of the smaller towns. Hence the only examinations required are in arithmetic, geography, English grammar and the history of the United States. The deficiencies exhibited in these simplest elements of education are often most astonishing. It not unfrequently happens that students from high schools and private schools of some reputation are lamentably ignorant even of spelling, as well as the first principles of mathematics and language.

Though every county of Massachusetts, and thirteen other States and nationalities, are represented in the College, it is not unjust to affirm that not ten per cent. of all applicants for admission are as well qualified as they ought to be, considering their age and the length of time they have spent in school. There certainly seems to be some radical defect in a system of education which lays poor foundations. Whether the fault lies in the method of teaching, or in the number of subjects taught in our modern schools, is, perhaps, not easily determined. If the College can aid in securing greater thoroughness in our educational system by insisting upon an accurate and available knowledge of the elementary branches as a condition of admission to its privileges, it will accomplish an incidental good of no small moment.

The Education Offered.

The course of instruction occupies four years, and is arranged so as to combine the largest practicable amount of literary and scientific culture and training, with a knowledge of the theory and art of agriculture and horticulture. Civil engineering, veterinary medicine, chemistry and military tactics are appropriately prominent branches in the regular curriculum, and it is hoped provision may soon be made for a post-graduate course of one or two years for such as desire to prepare themselves for the practice of one of these professions. It is intended that every graduate of the College shall be rendered familiar with the principles and methods of scientific and profitable agriculture, with special reference to those branches of farming best adapted to Massachusetts. It is, however, obviously impossible to impart to students totally unacquainted with farming a complete knowledge of all the details of this complicated business. The object of the system adopted is rather to perfect the education of young farmers by mental culture, by scientific training, and by the study of the best models of domestic animals, of farm-implements, and of agricultural operations in every department of the art. With a well-trained mind, a sound body and a good character, with a knowledge of books and the proper methods of investigation, and with the general intelligence acquired by four years' association with his fellow-students from various sec-

tions of the country, as well as with thoughtful, earnest and skilful teachers, the graduate of the College ought to be prepared to begin a useful and successful career in agriculture. The measure of his success must, however, be largely determined by his natural ability, the means at his disposal and the circumstances which surround him.

Accommodations for Students.

The number of students since the opening of the College has been constantly increasing, and has always been larger than the dormitory and lecture-rooms could properly accommodate. In 1867, there were 56; in 1868, 85; in 1869, 119; in 1870, 147; in 1871, 166; and in 1872, 171. The most imperative want of the institution at the present time is a public building, to contain a chapel, library, museum and lecture-rooms. This edifice should be constructed of stone, from the excellent quarry of gneiss belonging to the corporation, and should be furnished with a suitable tower for a bell and clock. Whenever this shall be completed, the lower story of south college may be converted into dormitory apartments for sixteen additional students. There is reason, also, to think that a new dormitory building would be promptly occupied as soon as finished.

College Faculty.

The organization of the faculty of instruction is believed to be admirably suited to the accomplishment, in the most economical and efficient manner, of the objects of the College. Brief reports upon the several departments by the officers in charge, are presented herewith, which, considered in connection with the schedule of studies appended to the catalogue, will afford an approximate idea of the education attempted. The president, with eight resident professors and a few non-resident lecturers, can thoroughly teach all the subjects which may be profitably introduced into such a definite course of study and training as is best adapted to the average attainments and capacity and prospective wants of our agricultural students. The number of hours required for practical exercises in the various departments renders optional studies im-

practicable, even if they were imagined to be in any manner advantageous to those who are candidates for a degree.

Anniversary Week.

The exercises of graduation week were attended by a large number of visitors, among whom were many members of the State government, and the Board of Agriculture. The graduating class, numbering twenty-four, were addressed by His Excellency Governor Washburn, who spoke eloquently on the importance of education, saying that the State could better afford to maintain common schools than reform schools, and colleges than penitentiaries; that there was special need of institutions for the advancement of the industrial arts; and that it was the duty of the people to cherish the Agricultural College. In conclusion, he exhorted the young men to show, by their deeds in after-life, the high practical value of the training they had enjoyed, and reminded them that the success and reputation of the College must be inseparably associated with the conduct and career of its graduates.

The address before the literary societies was given by Prof. D. C. Gilman, then of Yale College, but now president of the University of California. His subject was, "The Relations of Schools of Science to the Culture of New England." He began by congratulating the people of Amherst on their felicitous solution of the problem of literary and scientific culture. Two friendly institutions, one of letters and one of science, here stand side by side, and each helps the other by concentrating in this quiet spot so many facilities for instruction. This prosperous College of Agriculture, with its ample woodlands, meadows and gardens, its greenhouses, herbarium and collections, its convenient halls, its military skill, its naval trophies, its corps of expert instructors, its well-filled ranks of students, its treasury steadily replenished by public and private bounty, all this the fruit of a single decade, bears witness to rapid progress in scientific and industrial education; while the rapid growth of Amherst College at the same time, shows that scientific schools have not been encouraged at the expense of literary foundations.

After enumerating some of the characteristics of New England soil, climate and scenery, and referring to the rapid

increase of Massachusetts, Connecticut and Rhode Island, in population, wealth, manufactures, railroads and educational institutions, the orator remarked that certain tendencies to a bad civilization were observed with apprehension by many. Prominent among these were the growth of large towns and manufacturing villages, with a simultaneous decline of rural communities; the rapidly increasing preponderance of corporations; the decided infusion of foreign elements, destroying the homogeneous character of our population; and the serious controversies between capitalists and workmen, leading to prolonged and disastrous strikes.

Among the means at our disposal for successful resistance to these dangers, industrial education was most important, and within the ten years since Abraham Lincoln signed the bill granting land to agricultural colleges, great results had been reached in New England. Harvard and Yale have departments of science, while Amherst, Brown, Dartmouth and Wesleyan University at Middletown are giving enlarged attention to it. Boston has the Institute of Technology, Worcester the Free Industrial Institute, while here we have this distinctively Agricultural College, of Massachusetts in name, of New England in reality. Nestled in this richest part of our Connecticut Valley, open to students from the river's source, central in position, in climate and influence, it is destined to be to New England our central school of agriculture, and a leader among the national institutions.

In naming some of the beneficial influences to be derived from these sources, he said: "The farmer especially needs to learn all that he can about the laws of the weather, the theory of vegetable growth, the influence of soil and air, the principles of stock-breeding, &c., in order to compete with the farmers in more favorable regions. On the other hand, our thrifty towns and villages, with their busy workmen and prosperous capitalists, furnish a ready market. The better the produce, the quicker it will sell; the more skill in gardening, the more savings in the bank. Every one of these large towns will need, also, a public officer, to be known as the city's civil engineer, to survey lands, advise as to drainage and sewerage, the introduction of water, and the laying out of parks and pleasure-grounds. Dynamic engineers will also be wanted, to deal

with force and motion, with the steam-engine, the water-wheel, &c. Chemists and metallurgists will have callings of like importance, and skilled labor of all kinds will be needed. Every large town will require a medical and sanitary adviser, and teachers for the lower schools will be called for at all such colleges as this is. There will be no lack of work for the disciples of the new education, whose advantages are, that it adds to human knowledge, insures the productive power of the community, and prevents waste, improves health and lengthens life, and brings leisure for social, intellectual and moral culture. Its dangers are imaginary and real. Its imaginary dangers are, that in the increase of scientific culture, literature will be slighted, materialism will dominate, and religion be undermined. Its real dangers are, that too short a preparation will be made, and the culture obtained will be too narrow; that too many beginnings will be made, and too little brought to perfection. One thing is certain, that New England must depend henceforward for her wealth and influence on her proficiency in education, her skilled labor, and the alacrity with which every newly recognized principle of science is communicated to her scholars and artisans. If she will do in the coming years what she has done in the past, she will easily maintain those moral, political and religious sentiments which are her chief glory and renown."

The Farm and Garden.

The general management of the farm and vegetable garden, under the present system, devolves upon a committee, consisting of the president, the professor of agriculture and of chemistry, and the farm superintendent.

During the past year, Professor Stockbridge has had charge of the garden, which has been kept in good order, and produced an abundance of vegetables in great variety. The experimental portion has been devoted to the cultivation of Japanese plants, the seeds of more than one hundred varieties of which were furnished by former students of the College who have returned to their native land. Many of these varieties are very singular in appearance, and a few promise to be of some value, but the best modes of cooking and utilizing them have still to be learned.

The immediate direction of the active operations on the farm, the care of teams and stock, the buying and selling, and the general oversight of employés, whether hired laborers or students, excepting the class-work, have been intrusted to Mr. John C. Dillon. His annual report, herewith presented, contains an interesting statement of his intelligent and faithful endeavors, and his accomplished results, which, under all the circumstances, must be regarded as quite satisfactory.

Agricultural Experiments.

It is deeply to be regretted that no fund has yet been provided, either by the State or by individuals, to defray the necessary expense of carrying on through a term of years a well-ordered and systematic course of experiments for the improvement of agricultural science and practice. Prof. S. W. Johnson informs us that in Continental Europe there are now in active operation no less than fifty-six government establishments maintained for this purpose, and employing more than one hundred educated men in making scientific investigations for the advancement of agriculture. Some of the stations in Prussia are aided to the amount of $2,000 per annum, while the one at Rome receives annually $3,000, and the one at Munich, $4,500. It is a remarkable fact that since the first experiment station was founded in 1852, their number has steadily increased, and their necessity been universally admitted. As an example of their work it may be stated that the station at Rome reported upon the chemical composition and value of 287 commercial fertilizers in the year 1870. It has also been announced by a Prussian minister of agriculture that the results of experiments upon the feeding of animals, obtained at a single station, have been of more direct advantage to that country than the entire cost of all the stations up to that time.

The trustees of the Pennsylvania Agricultural College have undertaken to carry on three experiment stations in different parts of that State. The tract of land set apart for experimental purposes near the College contains 35 acres, and is divided into 264 plots, each consisting of one-eighth of an acre. Upon these plots it is proposed to experiment in the most exact and thorough manner, through a series of years,

upon questions relating to the rotation of crops, modes of cultivation, fertilizers, and different varieties of seeds, grains and vegetables.

The land, the scientific investigators and the apparatus are all ready at Amherst, but the work cannot go forward until at least $1,000 per annum has been pledged to defray unavoidable expenses. Might not a portion of the money now annually devoted to the support of cattle-shows be profitably expended for this object?

Notwithstanding the want of reasonable encouragement, Prof. Goessmann, with his usual energy, has labored to achieve something in this direction the past year. His investigations upon the sugar-beet as a profitable crop in Massachusetts, which were published in the College reports for 1871 and 1872, have attracted much attention, and been widely distributed both in this country and in Canada. The New York State Agricultural Society has taken much interest in the subject, and has caused sugar-beets to be raised in many portions of the State the past season, which have been sent to Amherst for analysis. Another result of the discussion has been the translation into English of the agricultural portion of the standard German treatise upon beet-sugar manufacture, by Walkhoff, for the benefit of the farmers of the Empire State. Besides several prosperous establishments in California, an extensive beet-sugar factory has been put into successful operation this winter at Freeport, Illinois.

The most important experiment in this connection in progress at Amherst the past season has been the growing of seed from carefully selected beets of the best sorts, which will be tested next year. The most approved labor-saving machinery for sowing, cultivating and harvesting the beet-crop was imported from Germany last year, at an expense of nearly eight hundred dollars, for the purpose of demonstrating the lowest cost of raising beets in Massachusetts. Through unforeseen delays it did not arrive in season for proper trial, but was used enough to show its exceeding value. A description of the different machines will be found in the report of the farm superintendent, and a more satisfactory experiment is hoped for next year.

The last legislature, with judicious liberality, enacted a law

exempting all property employed in the manufacture of beet-sugar from taxation till the year 1882.

The able paper of Professor Goessmann on commercial fertilizers, accompanying this Report, is the result of much study, and full of valuable facts and suggestions. It will be strange if the farmers of the Commonwealth, who are so constantly swindled, either by purchasing manures at exorbitant rates or by being prevented from buying what they need through fear of being cheated, do not provide some means to encourage further investigations, which the professor would gladly carry on for their benefit, if the necessary expenses were paid.

It is an interesting fact that, since the last report, two patents for improvements in agricultural machinery have been granted to Mr. Clarence E. Brown, who was for four years a student at the College. This is a hopeful indication of results to be obtained from the education of young men in connection with practical affairs, and there can be no doubt that the liberal endowment of an experiment station at the College would be of immense advantage in an educational point of view. Nothing so stimulates a desire for scientific knowledge among students as familiarity with its applications in the industrial arts, and a personal acquaintance with the processes of original investigation. By the selection and employment as assistants of the most competent young men in the experiments undertaken, a large number of trained observers would be developed, whose capacity for usefulness as promoters of agriculture can hardly be overestimated.

In order to increase the desire and ability for close and accurate observation, a course of instruction has been initiated the past year in the use of the compound microscope, under the skilful direction of Prof. H. J. Clark. With the income of the Hills Fund for the advancement of botanical knowledge, six valuable instruments, having a magnifying power of four hundred diameters, have been purchased. This number will be increased, if necessary, although every student who can afford it will be advised to procure one for his own permanent possession and assistance in after-life.

The Botanic Garden.

At the recent meeting of the Board of Agriculture in Barre, the College was represented by the President, Professors Peabody and Stockbridge, Farm Superintendent Dillon, Gardener Ware, and a considerable number of students. The relations of botanical science to agriculture were fully discussed in one of the evening lectures, and an effort made to awaken an interest in this department of the College. As the lecture will be printed in the Annual Report of the Secretary of the Board, the subject, notwithstanding its exceeding importance, will be no further considered in this place, than simply to state the amount of money required before the planting of the garden and arboretum can begin, and suitable instruction be given in horticulture.

To complete the Durfee plant-house according to the original design, and to erect necessary structures for the propagation of plants, the forcing of vegetables, flowers and fruits, $25,000 are needed. The general fund for the perpetual maintenance of the botanic garden, amounting to at least $50,000, ought to be secured and devoted to this specific object before any attempt is made to lay out and plant the ground which has been selected for this purpose. The men are ready to begin the work, the plans are perfected, and the place is prepared,—only the money is wanting. While such a garden as is proposed is attached to almost every university and agricultural school in Europe, there is not one in America. With all our boasted excellence in educational affairs, we are lamentably behind in this respect. Will not some one of the numerous wealthy patrons of literature and science who adorn our age supply this deficiency, and thus secure for himself the gratitude of the people and the honor of an enduring memorial, combining the highest beauty with eminent utility?

Board of Trustees.

During the year, several important changes have occurred in the Board of Trustees.

Paoli Lathrop, Esq., of South Hadley, died of paralysis, February 3, 1872, after several years of wearisome prostration and confinement from the active labors of life. He was

born in Wilbraham, Mass., May 14, 1797, and was therefore nearly seventy-five years of age at the time of his decease. His first occupation, after finishing his common-school education, was teaching, in which he continued with marked success for ten years. Afterward, he was employed as clerk and book-keeper in a mercantile house, for a limited period. In 1833, he entered upon his business as a farmer in South Hadley, and won for himself an excellent reputation as a man of enterprise, integrity and sound judgment. He early became interested in the breeding of Shorthorn cattle, and, by the introduction of superior stock, greatly benefited the agricultural interests of the State, and especially of Hampshire County. Mr. Lathrop was constantly honored by his fellow-citizens with public offices of various kinds. He was prominent in the management of town affairs, was three times sent to the legislature, was president of the agricultural society at Northampton for many years, and its representative on the Board of Agriculture. When the Agricultural College was chartered, in 1863, Mr. Lathrop was naturally selected as the member of the corporation from Hampshire County, and discharged the duties of his trust with remarkable fidelity and efficiency. Even when incapacitated from attending the meetings of the Trustees, he lost none of his interest in the affairs of the institution, and preferred to retain his connection with it to the last. In his decline, he enjoyed the consolations of religion, having united with the Congregational church a few years before his death.

The following resolutions, from the pen of Hon. Marshall P. Wilder, were adopted by the Trustees :—

"*Resolved*, That in the death of Paoli Lathrop, Esq., this Board recognize the loss of one of its earliest and most devoted members; a gentleman eminent for his high integrity and his unblemished character, distinguished alike as a practical farmer and by his untiring zeal for the advancement of the cause of agriculture, and for the establishment of the Massachusetts Agricultural College.

"*Resolved*, That as an expression of our symp thy with his afflicted family, a copy of these resolutions be transmitted to them."

Another vacancy was caused by the resignation of Hon. D. Waldo Lincoln, who was elected as the member from Worcester County, when the College was chartered. Mr. Lincoln

was an earnest laborer in the early efforts to locate and organize the institution in the best manner, and was induced to vacate his office, after nine years of faithful service, only on account of the requirements of his business engagements.

In place of Mr. Lathrop, the Board has elected John Cummings, Esq., of Woburn, a gentleman distinguished not only for his business talent, but for his liberality and enthusiasm in the promotion of industrial education. Though deeply engaged in the manufacture and sale of leather, he is one of the largest farmers in the State, owning seven hundred acres in one tract, and producing milk, vegetables and fruit in large quantities for the Boston market. As president of the Middlesex Agricultural Society, he has begun and nearly completed a plan of improvements by which their grounds and buildings are rendered remarkably convenient and attractive.

The s ccessor of Mr. Lincoln is William Knowlton, Esq., of Upton, a wealthy manufacturer of straw goods, but also deeply interested in agriculture. He owns, in Upton and vicinity, about two thousand acres of land, and not only delights in thoroughbred cattle, but is especially enthusiastic in reclaiming and improving boggy meadows and other waste places. He is president of the Worcester South-east Agricultural Society, and a member of the State Board of Agriculture, and has shown in former years, by frequent gifts, his faith and hope in the College.

Conclusion.

It is a remarkable fact that, while the higher institutions of learning in our country are under the direction of corporations, consisting very largely of most judicious and successful business-men, they are almost without exception in want of money, not merely for improvements but for current expenses. The new education, now so fashionable, with its numerous parallel courses of optional studies, and its insatiable demand for scientific books, apparatus, models, laboratories, museums and teachers, necessitates such extraordinary expenditures that a financial system which would formerly have been regarded as grossly extravagant, is now everywhere conside ed me ely an evidence of thrift and enterprise. This laudable effort to multiply and improve the means of instruction, and render

education as thorough and practical as possible, has fortunately been appreciated by the public. Wealthy patrons of learning have, within a brief period, bestowed many millions of dollars upon colleges and technical schools, while state legislatures and the national Congress have responded to the numerous petitions for aid with astonishing liberality. The cash value of intelligence in all the pursuits of men is beginning to be understood, and the necessity for applying the highest science to the industrial arts is everywhere felt. Hon. Justin S. Morrill, while advocating in the Senate of the United States a bill for the further endowment of national colleges, has recently said, "A practical education is more than ever required for all classes, one almost as much as another, and certainly required for the industrial classes of the American people, in order to give them the sovereignty of their natural faculties, to make them happy and independent personally, to bring out their highest moral and productive value to the country, to rescue them from littleness in their intercourse with this world, and to render immortality even more desirable in the world to come."

Under such enlightened leadership, the Senate passed the bill by a two-thirds majority, granting to each State 500,000 acres of land, to be sold for the benefit of the schools and colleges endowed under the Agricultural College Act of 1862. If this, or some similar measure be enacted, it will add ultimately a sufficient sum to the annual income of the College, to enable it to go forward upon the plan which has been so successfully inaugurated.

The total expenses of the institution, on its present basis, are about $30,000 per annum, exclusive of the farm, which, with its complete equipment, should be no burden to the general treasury. Of this sum, only $18,000 are to be devoted to the maintenance of the officers of instruction, which will be admitted by all who are familiar with other institutions to be a very small allowance. It cannot well be diminished, and should be increased whenever practicable.

The income from the endowment fund is $15,000, or only one-half what is indispensable for the support of the institution. The receipts from tuition, with the present limited accommodation for students, may be estimated at $8,000. While most

of the agricultural colleges of the country are able to give free instruction in consequence of their more ample endowment funds, it has hitherto been absolutely necessary for the Massachusetts College to charge for tuition and room-rent. With an earnest desire to favor the sons of farmers, and encourage them to obtain a professional education, the Trustees have made the expenses of the students as low as possible, and will continue to do so. If, however, the tuition should be raised to $150 per annum, which is the ordinary charge in the best scientific schools, with $75 additional for students of practical chemistry, the result would be to exclude many young men desirous of enjoying the privileges of the College, who are entirely dependent upon their own efforts for means of support. In most of the older colleges charitable foundations exist, from the income of which all indigent scholars receive whatever aid is essential to their continuance in a course of education. Until similar provision is made at the Agricultural College, it must be difficult to determine what plan ought to be adopted. At the present rate of charges, an industrious, economical and intelligent student can work his way through the four years with $1,000 in money. It would seem as if that was as much as a farmer of common pecuniary ability could afford to pay for the education of one of his sons. Until the income of the College is increased by a large grant from Congress, or liberal donations from other sources, the annual deficit of $7,000 must be appropriated by the legislature, or charged in tuition. As the indigent scholars in our colleges usually improve in the best manner their opportunities and talents, and become most valuable citizens, the State can well afford to deal generously with them.

The College, in order to accomplish in a desirable manner its mission as a training-school for young farmers and gardeners, and as an experiment station for the advancement of agricultural science and practice, should have a cash income of not less than $50,000, and additional buildings and apparatus costing at least $200,000. This would furnish accommodations for two hundred students, and enable the corporation to give free tuition to all who might need it. Notwithstanding the great difficulties arising from the present lack of means, there is much cause for thankfulness in the prosperity of the

College during the year past, and abundant reason to hope, with the blessing of Providence, for its continued and enlarged usefulness in the years to come.

Respectfully submitted,

By order of the Trustees,

W. S. CLARK, *President.*

AMHERST, January 1, 1873.

REPORT

ON THE

VETERINARY DEPARTMENT.

By Prof. HENRY JAMES CLARK.

REPORT.

President W. S. Clark.

Sir :—The instruction in this department began on the first term of the present academic year.

The freshman class have completed a course in elementary human anatomy and physiology, the main object of the instruction being to give the students a sufficiently comprehensive knowledge of the laws of hygiene, as based upon a general study of the anatomy of the human body and the mode of performing its various functions, in order that they may intelligently adapt themselves to the daily and hourly varying circumstances of their existence ; in short, that they may know how to take good care of themselves, and be able to foresee and avoid the evils of ill-health on the one hand, and to make the most of all that is good in this life or the other.

As a general fact, the class has taken hold of the subject with avidity, and kept up the interest to the end of the term, giving much promise of excellence in the years to come.

With the juniors, a beginning has been made in comparative anatomy and zoölogy ; while the senior class has been busied more or less with the study of comparative physiology.

It will be impossible to make even a moderate advance in veterinary pathology, without previously securing a thorough knowledge of the principles of healthy physiology among our domestic animals. Between two evils, it will be better in the main to attempt, as far as possible, to insure a good groundwork of comparative physiology, than for want of time to go superficially over both fields, and end the course with very little that will bear close scrutiny. Instruction in general pathology would then secure more attention and interest, and produce a better effect, than to dwell in detail upon a few special cases without suitable preparation.

Laboratory Instruction.

There are two different ways of teaching by the objective method, and both of them may be made highly available under the proper conditions, and with a sufficiency of apparatus. Untrained students should first be led through a general course of comparative anatomy and zoölogy, and required to recite, and allowed to discuss freely upon the topics assigned for the time-being, with abundant illustrative preparations of anatomy before them.

Having mastered the general principles of structure and relation throughout the length and breadth of the animal kingdom, the rawness of total ignorance is supplanted by a new habit of thought, and a proneness to make further inquiry upon meeting with any object in nature. Here, then, comes the time for laboratory practice. Supplied with scalpel and magnifier, the student should be required to work out topics upon unprepared specimens. If he has acquired the smallest grain of interest in the matter previously, patience will enter where it could not possibly have existed before. He learns the art of seeing and knowing what he looks at; he becomes by degrees an observer; and in doing that, he is also becoming unconsciously a draughtsman, and when required, as he should be, to produce with pencil what he sees, if he wants to do it, he will do it instinctively.

Yet, with all these supposed advantages, a student in the regular course of this College cannot become a thoroughly trained, self-reliant veterinary practitioner, and, simply for the want of time, in the midst of his other equally imperative duties, to master all that which, by the habit of usage, makes one a skilful and ready worker. At best, he will be able, if a farmer, to administer intelligently only to the general welfare of his stock, and treat the more common ailments with probable success. There can therefore be but one course for him to pursue after he has graduated. He must enter upon a special course of training, devoted solely to the one purpose of becoming a veterinary doctor. A *post-graduate* course seems to be demanded, when we consider the matter in this light. Before that can be established in our College, however, if the proper authorities see fit to do so, we must first

fill up the measure of requirements appertaining to the current course already in our hands, and most particularly in reference to the laboratory work of the student.

This second stage of the objective method calls for what very few colleges possess, that is, an abundance of duplicate specimens; and no corporation, however well advised of the want, can appreciate the necessity for such duplicates so well as the professor who has suffered for the lack of them. At this point, we very naturally turn to the formation of a museum,—a working collection of comparative anatomy.

At the opening of the present year there were very few specimens belonging to this College which could be said to be available for the purposes of study. The State collection must of course remain untouched, as a representative of its kind, and should not be subjected to the clumsy handling of untrained students. As soon as it can be duplicated, it ought to cease to be used for lecture-room illustration by the professor. At the time referred to, the whole alcoholic collection was inspected carefully, and alcohol supplied where needed, and the irrecoverably injured specimens were thrown away.

In the formation of this museum of comparative anatomy, the present aim is to dissect out and mount such parts and organs of the bodies of animals as are most needed and indispensable, in the meanwhile relying upon pictured illustrations and blackboard diagrams to explain the minor features of any topic.

The proper display of an anatomical preparation for class use, and for reference, requires all the skill of an experienced anatomist, and no small degree of patience, for the work is slow. And slower still it may seem to an expectant public, when it sees the cases filling up by almost imperceptible degrees, through the work of one man. There are no trained students to do this work, and it will require at least two years' instruction and practice to make one a reliable assistant, even in the roughest sort of work. A habit of carefulness comes not by nature in an anatomical laboratory; it grows up to usefulness only by thoughtful practice, and not a few mishaps. With large yearly appropriations, a collection could be bought in a short time, which would supply our most urgent needs; but as we are situated at present, your incumbent must alone

hew out his materials to the necessities of the occasion. Already, a considerable number of anatomical preparations have been made with the utmost care, and an eye to their general availability, and preserved in alcohol, within large stone jars. At the same time, a collection of diseased parts and organs has been initiated, with the view of forming a pathological museum. This will in time be a more important and rarer source of reference than the museum of comparative anatomy, because unhealthy specimens are not to be obtained in such relative abundance, nor in that variety, which the healthy kinds afford.

The private collection of the instructor is not so accessible as we wish it might be, for want of glass jars in which to distribute it, but these have been ordered from the manufacturer.

A human skeleton has been bought for $50. There are also needed gigantic models of certain delicate, or minute organs, such as the eye and ear, for lecture-room purposes. It is proposed to purchase these at once, if procurable in this country, by means of the present appropriation. Many other altogether or nearly as imperative needs have been noted, whose estimated expense would far more than consume the available funds. They may be purchased from time to time, as rapidly as the yearly appropriations seem to warrant, and, in all cases, would be a welcome accession to the apparatus of instruction.

Very little of scientific interest has thus far occurred within the province of this department.

There remains yet to be reported upon the autopsy of the Devon cow, which died of a wasting disease this summer. The microscopic investigations have not been completed, owing to the ill-health of your reporter, and, as it is only by such a mode of research that the true key to the disease seems discoverable, the subject is unavoidably postponed for the present. The skeleton of this remarkably fine animal is in process of preparation for the museum, and will be very valuable as a typical specimen to illustrate the structure of this ancient breed.

REPORT

ON THE

MILITARY DEPARTMENT.

By Prof. A. H. MERRILL, 1st Lieut. 1st Artillery, U. S. A.

REPORT.

President W. S. Clark.

Sir :—I have the honor to report that I have been in charge of the Military Department since the 20th of April, 1872. When I joined the College at the above date it was already well supplied with the latest model of the breech-loading rifle-musket, and all the other arms and munitions necessary both for practice and illustration. Some preliminary instruction had also been given in the tactics of infantry and artillery. During the remainder of the spring term dress-hats, and white belts, like those worn at West Point, were purchased by the students, and they were organized into a battalion of four companies, designated "The Massachusetts Agricultural Cadets," with permanent commissioned and non-commissioned officers.

It has been the intention throughout to adhere with system and persistence to the forms and customs of the regular army. It is doubtless impossible to give in our College a knowledge in any sense complete of the art of war, which Washington, in his last message to Congress, calls "both complex and complicated." It is, however, intended that hereafter every graduate of the institution shall be able to organize, clothe, equip, drill and command a regiment, and to do this so in conformity with the uniform system of standing armies as to successfully oppose them, or smoothly coalesce with them.

Besides this practical elementary instruction, it is deemed most desirable that sufficient time be set aside to give the higher classes some general knowledge of field-fortification, and the more general principles of out-post and strategy. Such instruction has already been given in the form of lectures, at such hours as could be obtained for the purpose. Additional time is, however, desirable, because, if at any time our gradu-

ates should be called upon for active military duty, such knowledge would very greatly increase their usefulness, on account of the scarcity of men qualified to construct the simplest earthworks, or perform the simplest duties of staff-officers. In the war of the Rebellion the want of men possessing such knowledge was shown by the rapid promotion given to those having very imperfect qualifications, and the utter failure of many who undertook to discharge such duties. These facts, and their resultants, in time, lives and treasure, so often talked about, and in their vital reality so little comprehended, form a reason not only for the above request but for any careful attention the Commonwealth of Massachusetts may bestow on this department of her only State College.

It may be remarked in this connection that ours is the only great nation dependent for its educated defence on a single military academy. France has eight, Austria over thirty, and Russia over sixty military schools. To counterbalance these may be urged the greater intelligence of our citizens, and our isolation; but let us recall one single fact—how, only a few months ago, pending the Alabama arbitration, we were startled, as if by some new thing, by the fact that England, with her countless steamships, could place every soldier on the British Islands within the fortress of Quebec sooner than we could march thither a force to invest it. While we may hope that similar emergencies are very remote, it cannot be the part of wisdom to ignore their possibility.

The only defect in the equipment of this department of the College is the want of a suitable dress-coat. The uniform of the battalion, as it now is, would be complete if this was added. The dress-hats, belts and gloves, obtained since April last, are just those to go with the finest uniform, and the trousers now worn need not be changed. In place of a coat the cadets have only a loose, ill-shaped flannel shirt, which has to be worn inside the trousers, and presents anything but a pleasing or military appearance. A coat equal to those worn by any military organization in the United States can be obtained for thirty dollars, and one such coat would last a cadet during his four-years' course. All the articles of uniform now worn by the cadets have been purchased and paid for by them, and it is thought that the

College might reasonably be asked to appropriate for this department something toward the purchase of these dress-coats. Students entering the College hereafter, of course, to provide themselves, as it would not be, with the four years before them, any special burden, while for the cadets now in the battalion, some of whom graduate in a few months, the burden would be considerable. The cadets might be willing to incur on their own account the expense of a dress-coat in preference to wearing the shirt they now have, but in this case it may be questioned whether it would not be better for the general interests of the College to bear at least a portion of this expense for them, so as to make each cadet's outlay proportionate to his remaining time. It is, at all events, most earnestly recommended that such steps as are deemed most advisable be taken to provide the battalion with a dress-coat. It is believed that this will be for the very best interests of the College, because the uniform of the cadets is a certain index of the military department of the institution. It is desirable, also, not only to maintain the present interest in this department, but to stimulate the feeling that it is an honor to belong to the battalion of Massachusetts Agricultural Cadets and to wear its uniform. The importance of this stimulus to the individual pride of the cadets will be appreciated by every one at all conversant with military organizations.

Napoleon's first act, when he was made emperor, was to elaborate the dress of his army, which he said had before made them look and feel "like mere policemen"; and Washington urged again and again, even upon the hungry poverty of the colonies, appropriations to beautify the uniform of the soldiers.

A close-fitting, shapely dress-coat is also very desirable to assist in habituating the men to the erect, healthy position of a soldier.

In short, this department will never be what it should be, either subjectively or objectively, until this coat, the only thing we need, is provided.

During the term just ended the dormitory-rooms of the College have been regularly inspected once a week. These inspections have been made in the manner pursued in the military academy at West Point, and cleanliness and order

have been insisted on in the minutest details. These inspections are believed to have been as beneficial to the cadets, both individually and collectively, as any duty that could possibly have been intrusted to the care of this department, and their results will speak for themselves to any one who may visit the buildings.

During the past term the senior and junior classes have also been instructed, under the care of this department, in topographical drawing, and their progress has been excellent.

In conclusion, I wish to commend the cheerful and gentlemanly manner in which the cadets have uniformly discharged all military duties, and to thank you for a hearty, consistent and efficient support of my department in all particulars.

REPORT ON THE DEPARTMENT

OF

MENTAL, MORAL AND SOCIAL SCIENCE.

BY PROF. H. W. PARKER.

REPORT.

President W. S. Clark.

Sir :—The three successive senior classes that have pursued mental science with me have shown a better degree of interest in the subject, I think, than might have been expected of those who in this study pass to a field very different from that of their previous labor. Of less average age, doubtless, than students of the same rank in classical colleges, with three years less of preparatory work, with no long-continued literary training, in short, without six years of Latin and Greek, many of them find it difficult to master the language of intellectual science, and to enter into its nice distinctions. I have endeavored to fix the main points in their minds by repeated reviews and rehearsals near the end of the trimester, all ranging at large being mostly limited to the first two months.

The question of preparing a pamphlet of printed interrogations has often been in my mind, and is worth considering as a means of concentrating attention on the essential points in the text-book, and awakening further inquiry. A serious objection to this plan is that it is not for the student's ultimate good, though it may facilitate study for the time ; he needs to find the hinges of a subject himself, to find for himself the essence of a page or chapter, if only he would. All true education is self-education, and must be made such, so far as may be.

As a help to senior studies and literary exercises, as well as in general to counterweigh the linguistic branches omitted from the College course, I offer the suggestion that at least one term of pre-seniority be given to the etymology of the English language, a study at once highly instructive and delightful, if appreciated.

This year it is already agreed to give the most essential

parts of moral philosophy in a few Sunday discourses, in place of taking up the subject by text-book. Pulpit instruction, of necessity, goes over much of the ground of practical ethics. The senior class should be questioned on the more special discourses now proposed, and hereafter, to avoid a yearly repetition of these sermons, questions in ethics can be given as addenda to recitations in mental science, the idea of right being one of the topics in that science.

Social science, in its large sense, is inchoate, and for that very reason, as well as for its exceeding importance, demands a course of judicious lectures. The more special science of exchange is taught in its general principles, which are clear and grand; the desideratum is an impartial history of the subject, statistical and universal, to be used as a reference-book.

In respect to the Sunday services, the good attention given has been encouraging. The Bible-class exercise has resolved itself into a brief, rapid lecture, for the most part the subjects of which during the past year have been chiefly the prophecies, the parables and the book of Exodus.

A goodly number of students have shown perseverance and religious principle in maintaining the organization and the weekly meetings of their society, called the Christian Union. The sittings are reported to be well occupied for the most part. Choice additions to the small library of the Union from time to time would do much to help forward the society and increase its usefulness. There could be no better opportunity for Christian generosity. The occasional presence of the officers and friends of the College at the devotional meetings of the Union would surely be acceptable and helpful.

In the reading-room of the College, supported by the students generally, the "New York Independent" and the "Christian Register" are the only religious papers I have noticed.

REPORT

ON THE

DEPARTMENT OF AGRICULTURE.

BY PROF. LEVI STOCKBRIDGE.

REPORT.

President W. S. CLARK.

SIR:—During the past year, the students in agriculture, both theoretical and practical, have manifested their usual degree of interest, and every required duty has been performed with cheerfulness and alacrity. Owing to the constant pressure of work in harvesting the various crops of the farm (all of which was done by the students), our required labor during the fall term was not so diversified in character as is desirable. Little opportunity was found to permit the several classes to engage to any great extent in the general business of farm-improvement. The laying out of drains, and the work of underdraining, could not be engaged in, partly for the want of tile. I would therefore suggest that the business of the farm be so arranged that, during at least one term in the year, students may participate in the labor of improving it, and that tile may always be kept on hand, to be laid exclusively by them in class-work, for the double purpose of having them become familiar with the best methods of performing such work, and to hasten the improvement of the estate.

The system adopted for keeping the tools used in class-work distinct and separate from those used in labor controlled by the farm superintendent and gardener, and for the proper care and preservation of the same, is working well, and doing all it can to teach the student order, care and method respecting the implements of the farm; but, in my judgment, it would be materially improved if each one could have a set of the ordinary hand-tools which are most constantly in use, to be exclusively his own, and he alone to be responsible for their condition and preservation. To accomplish this, a greater number of implements would be needed at the outset; but, eventually, it would not materially increase the expense, for

they would not be used so much, the method would insure greater personal responsibility in their care, and result in less need of repair and renewal.

Although the farm superintendent has done all in his power to obviate the difficulty, yet the want of a team to assist in many of the operations of class-work is a serious obstacle to its efficiency, the students being often obliged to perform with baskets and barrows work which could be accomplished more rapidly and economically with teams. It seems desirable that this should be remedied at as early a period as possible.

Our method of instruction in the theory of agriculture is by lectures, which are continued through more than three years of the College course, keeping the subject of agriculture prominently before the student much the largest portion of the time while he is connected with the institution. These lectures are conversational in manner, and are intended to give a thorough knowledge of the fundamental principles which are the basis of all correct, rational practice in the management of soils, and the production of plants and animals, and to qualify the student to engage in agriculture, or the pursuits related thereto, as a personal vocation, with intelligent satisfaction and success, or to judiciously superintend and direct agricultural operations. The entire course is systematically arranged by topics, commencing with "The Importance of Agriculture as an Occupation, and its Influence on Private and Public Welfare and Improvement." This is followed by an exposition of the application and practical value to agriculture of scientific knowledge. Our next study is the soil, its origin, the causes which produced it, its composition, the offices of its different kinds of matter and their influence on each other. Then we consider the effect on the soil of cold or frost, of heat, of air, and of water. This is followed by an examination of the chemical and physical condition and changes of soil. This leads to the plant, as a general topic, which is examined from an agricultural rather than a botanical standpoint. It is considered with respect to its characteristics and composition, its susceptibility to modification and improvement by culture, its organs and their offices, how it is influenced by temperature, air, water, soil and food. Next we inquire concerning the effect on the soil of producing

plants, naturally and artificially; what in each case are the results, and why; followed by an explanation of the various methods of culture and crop-rotation which may be resorted to to sustain its producing power. Then follows the subject of manures, which we consider in relation to their influence on the soil and plant, their kinds, quality, general and special adaptations. Then we examine the advantages and disadvantages of different branches of agriculture, as a vocation, general and special farming, selection of a location for each; regard being had to individual taste, soil, climate and markets. We divide and arrange the farm, locate and construct its buildings, adopt a yearly and a life system or plan, arrange the kind and rotation of crops adapted to its varieties of soil, and go through in detail a year of routine management of land, crops and stock. Then farm economy and accounts are considered, followed by domestic animals, stock-husbandry and everything related thereto, market-gardening in all its departments, forests and forest-culture, and fruit-culture. To avoid some of the real objections which exist to oral teaching, constant effort is made to secure on the part of the student such a record of the instruction given that it may be permanently retained, and at any time be made the basis of review and examination. To make this instruction more effective and useful, in certain parts of our course, it is extremely desirable that large additions be made to our very small agricultural cabinet. We need for illustration in the lecture-room, when considering the subject of implements of tillage and pulverization, a collection of farm-implements of the most ancient and modern manufacture,—models which shall show the principles of their construction and the various steps of progress in the several departments, and embody the best ideas of the best farmers and mechanics of modern times. It is also very desirable that in the department of labor-saving machinery for the farm we should be supplied with models to enable the teacher to present clearly the object of their construction and use, the principles involved, and to direct attention to desirable improvements. Though the College now possesses specimens of nearly all the improved breeds of cattle, which are freely used in the course in stock-husbandry, principles of breeding and the improvement of cattle, yet we

need a large collection of diagrams, paintings and sketches, which can be quickly and easily used by the lecturer to display the comparative faults and excellences of different breeds and kinds of domestic animals, the various stages of change and development from the original type to present forms and qualities, and to show minutely the points which it is the desire of the breeder to obtain. The use of such diagrams would greatly enhance the value of the instruction given and more than compensate the cost.

These suggestions respecting the wants of the agricultural department are intended to apply to its present needs and somewhat straitened circumstances; but I most sincerely hope the day is not far distant when it will have assigned to its special use a suite of apartments consisting of a lecture-room, suitably furnished with appropriate emblems and diagrams, and, adjoining, cabinet and museum rooms, supplied with everything needed to make the instruction of the professor of agriculture as interesting and useful as possible.

REPORT

ON THE

DEPARTMENT OF LANGUAGES.

By Prof. H. H. GOODELL.

REPORT.

President W. S. Clark.

Sir:—I have the honor to submit the following Report on the department of language:—

One of the chief difficulties experienced in this department has been the poor preparation of the students presenting themselves for instruction. It has been a constant uphill work endeavoring to teach a foreign language to those who were ignorant of the structure of their own. Either the standard of admission should be raised, or a longer time devoted to the mastering of each language. The object of instructing the students in the modern languages being to enable them to read scientific works in the German and French, the effort has been to secure a fluency of translation and correctness of pronunciation. Of the three terms set apart for this work with each language, the first has been devoted to acquiring the principles of the grammar, and the other two to translation and pronunciation. In the last term, some historic or scientific work, having a reference to the general course of study in the College, has been usually read. The same authors are not read from year to year, but they are varied with each class.

The study of English literature has been carried on, partly by means of a text-book, and partly by oral instruction. It has been prefaced by lectures on the formation of the language,—the evolving of the English out of its different elements, with a slight sketch of the literature prior to the time of Chaucer,—and has been supplemented by lectures on the different characteristics of each period, the manners and customs of the times, and their consequent effect upon the literature of the nation.

REPORT ON THE DEPARTMENT

OF

PHYSICS AND CIVIL ENGINEERING.

BY PROF. S. H. PEABODY.

REPORT.

President W. S. Clark.

Sir :—Pursuant to request, I present the following statements and suggestions concerning my duties in the College :—

Department of Mathematics.

During the year, I have taught algebra, geometry and trigonometry, and the work done by the classes under my instruction has been for the most part creditable. The substitution of algebra for commercial arithmetic and book-keeping, during the first term of the freshman year, is a step in the right direction. Further progress of the same kind would in my opinion add much to the character and usefulness of the College. At present, its mathematical course begins too low and ends too low. It seems very desirable that candidates for admission to the freshman class should pass a substantial examination, not only in the subjects now required, but in algebra, at least to quadratic equations and in plane geometry. It would then be possible to find a place in the course for analytical and descriptive geometry, and possibly for the elements of the calculus. The introduction of these topics is urged, not for display, nor even for the discipline, which it is now fashionable to deny them, but because they are implements most useful and necessary for performing subsequent work. Without their aid the student of to-day, in any department of mechanics, physics or engineering, labors at an immense disadvantage, and this the more because he does not even know what help they might afford him.

If these additional requirements should in any case delay a student in the public school at his own home for another year, it is quite possible that such delay would be fully compensated by the greater maturity with which he would come to all the

studies of his collegiate course, to say nothing of the better judgment with which he would meet the temptations of college life.

Department of Physics.

Instruction has been given in mechanics during the first term, in physics during the second term, and in astronomy during the third term, this being the work of the junior year. Hitherto this department has suffered for the want of suitable apparatus, but this deficiency is now in part supplied. The appropriation made at the time of my appointment is not yet wholly expended. Among the instruments already bought, or under contract, may be mentioned a superior air-pump, Atwood's machine, a hydraulic press, illustrations of mechanical powers and forces, a Holtz electrical machine, an induction coil, a Bunsen's galvanic battery of fifty large cells and a variety of suitable accessories. This work has been made for the College by Messrs. E. S. Ritchie & Sons, of Boston, and is of undoubted superiority.

The chief difficulty in the way of satisfactory progress in this department is the want of time. It is not possible to discuss the elements of mechanics, of the pressure and equilibrium of solids and fluids at rest and in motion, and the strength of materials, in one term of thirteen weeks, diversified with sundry cattle-shows and a regatta. If anything, it is still less possible to cover the topics of pneumatics, and of the vibratory forces, in the same time. The work can be best compared to a brief visit to a vast museum, where one wanders from room to room, looking at nothing in particular, and only seeing what is to be seen, possibly learning where to look for this or that, if he desires more intimate acquaintance. Conscious of this state of things, I have not even opened the doors to several departments, but have confined myself to a few topics, selecting such as seem to be of most direct practical application, and those which could be most readily illustrated.

Department of Engineering.

Instruction has been given to the sophomores in the theory and practice of land-surveying, to the juniors in topographical surveying, and to the seniors in the theory of road-building. In connection with each of these subjects, constant practice

has been given in the field, with the proper instruments, each student having his share of work under the eye of the instructor. Much interest has been manifested, and the students have done much more than the regular assignments, either upon the farm as practice or off the farm for compensation. For this extra work, every facility has been given, by the loan of instruments, as well as by advice and explanation. It has happened that important engineering data, as determined by our students, have been verified by the rigid scrutiny of experts, who had declared the facts impossible, and the mere guess-work of the boys.

During the year, a Burt's solar compass has been added to our field-instruments, and the seniors have been taught its theory and use. Additional field-instruments will be desirable for the economical working of the present sophomore class, who will take the field in the next spring term. It will also be desirable to adopt some system by which members of the higher classes may be detailed to instruct squads in surveying, according to the system now practised in the military and agricultural departments.

REPORT ON CHEMICAL DEPARTMENT.

By Prof. CHARLES A. GOESSMANN.

REPORT.

President W. S. Clark.

Sir :—In compliance with your request, I state subsequently in detail the course of studies hitherto pursued in the chemical department, with a few suggestions for future requirements. The instruction in chemistry begins with the freshman year, and continues until the second term of the sophomore year. Three terms are devoted to lectures, with experimental illustrations, and to recitations on these lectures, five hours each week being occupied for that purpose. The practical exercises begin with the last term in the freshman year, and continue for three consecutive terms, engaging each week six to eight hours. The first term in the freshman year is devoted to an exposition of the various influences of the physical agencies, as heat, light, magnetism and electricity, on chemical phenomena. The chemistry of elementary substances, with practical illustrations, occupies the second term. The third term is devoted to organic chemistry, with particular reference to agricultural and industrial applications. The laboratory exercises of the first and second term are occupied with the study of the properties of the basic oxides and the acids in their isolated condition and in mixtures. The last term is turned to account for the examination of important industrial products, commercial fertilizers and soils. These examinations are rendered more instructive by a weekly lecture on the chemistry of the soil and of fertilizers, with experimental illustrations in quantitative analysis. Towne's Elementary Chemistry, by Bridges, and Roscoe's Elementary Chemistry (latest edition), are recommended as books of reference in theoretical chemistry,—Will's Analytical Tables in laboratory practice. The instructions throughout are given with particular reference to the relations of chemistry to agriculture and

the allied branches of industry. Blackboard notes quite frequently occupy the place of the text-book, and the students are expected to copy and pass an examination on them. Those who are sufficiently advanced are instructed in quantitative analysis. I do not favor many exercises in quantitative analysis for the entire class, since the benefits derived from it do not compensate for the sacrifice of time for those who pursue the regular course of instruction. Whatever might be accomplished in that direction would be at the expense of efficiency in qualitative analysis, which is, after all, the first requirement of a good chemist. Opportunity is also offered for private instruction, concerning special branches of industry, to those who desire them.

The running expenses of the laboratory for chemicals is met by a charge of $5 per term to every student who engages in laboratory work. A stock of apparatus for ordinary laboratory exercises is kept on hand, and the students are furnished with whatever they may need at cost, the amount being charged to them in their term-bills. This apparatus may be returned at any time, and its value will be credited, at liberal rates, to the owners. Special analyses and investigations thus far carried on have been necessarily planned with reference to the limited means and time at my disposal. It would be desirable to enter upon some systematic investigation concerning the influence of special fertilizers on farm-plants upon suitable fields, as well as in pots, provided the necessary amount of assistance, and of suitable apparatus, could be obtained. I believe it to be for the interest of the College to offer inducements to graduates who have made themselves noticeable for interest and efficiency in chemistry, to remain and assist in the laboratory and field-work of such experiments. In regard to the pecuniary means required to start some systematic series of practical investigations, I prefer at present to give no farther specifications, yet will endeavor to present my views as soon as they shall have been carefully considered. Meanwhile, I propose to turn the resources on hand to good account.

REPORT ON COMMERCIAL FERTILIZERS.

By Prof CHARLES A. GOESSMANN.

REPORT.

One of the most important features of the present day in the management of the farm is the general and extensive use of commercial concentrated fertilizers. Their merits are so well established that a rational and thorough system of agriculture is thought impracticable without their assistance, particularly when it is proposed to apply them in connection with stable-manure.

It is but thirty years since the mineral constituents of plants were looked upon as being merely of incidental occurrence, and without any essential bearing upon their development, but these views have been entirely changed in the progress of science. Numerous and more exact chemical analyses of the ashes of plants, which accumulated during the beginning of the present century, began then to engage the attention of scientific investigators. In comparing the ash-constituents of different plants, they soon noticed that certain mineral elements were present in a more or less conspicuous proportion in every plant, and the general occurrence of these substances led ultimately to the quite natural assumption that their presence might be necessary for the performance of some physiological process of vegetable life. Actual experiments, instituted under well-defined circumstances for the purpose of testing this view, proved quite conclusively that a certain kind and a certain amount of mineral elements are indispensable for the complete development of a plant, and that, in case its own ash-constituents are not supplied, the plant may come to blooming, yet it will not produce a perfect seed. To Professor Justus von Liebig, before all others, belongs the merit of pointing out these important relations. It cannot be without historical interest, at least, to recall here the fact that even the use of guano was urged by him in 1840, on the strength of his analytical results, and its virtues explained by reference to its constituents, while as yet not one pound of it had been used upon the farms of Europe.

Alexander von Humboldt's report, in 1814, concerning the existence of the guano-beds upon the Chincha Islands, and the use of that substance as a fertilizer by the Peruvians, had passed by unnoticed. In citing this instance it is unnecessary to mention that I am fully aware of the well-authenticated statements that the dung of fowls was highly valued many centuries ago by the ancient Romans, and that wood-ashes, bones, gypsum, lime, marl, &c., were used more or less effectively in agricultural industry previous to the period referred to above. Yet it will be conceded that their essential relations to plant-life, as we understand them at present, were then unknown.

The successful introduction of mineral fertilizers for agricultural purposes is one of the striking illustrations of the influence and the value which exact modes of inquiry, with well-defined questions, have over mere experimenting, without a previous correct appreciation of the agencies and the principles involved in the operation. True progress in agriculture can in almost every instance be proved to be the result of the application of such rational modes of investigation as every branch of natural and physical science has sanctioned in its own field of inquiry. To begin with an analysis has proved to be here, as elsewhere in experimental science, the safest and most economical course to secure a desirable foundation for synthetical attempts. The recent improvements in general farm-management do not consist in the introduction of any particular new system; since to keep up the fertility of the soil by fallow and the rotation of crops, to use irrigation and drainage to enrich one portion of the farm lands at the expense of another by keeping a certain proportion of meadow-lands to secure manure for the grain-lands,* or to fertilize the

* 2,000 lbs. hay contain (Wolff) :—

Nitrogen,	26.2	pounds.
Total Ash,	133.2	"
Potassa,	34.2	"
Lime,	15.4	"
Magnesia,	6.6	"
Phosphoric Acid,	8.2	"
Sulphuric Acid,	6.8	"
Silicic Acid,	39.4	"

The relative proportion of phosphoric acid to potassa in the produce of the meadows is one of the former to four of the latter; in the case of grain-producing lands, one to one in wheat and one to two in Indian corn.

surface-soil at the expense of the subsoil, either by subsoiling or by cultivating deep-rooting plants—as lupine, esparsette, lucerne, beet-roots or red-clover, etc., for feeding purposes, and in the interest of fertilization, are all time-honored modes of operation of more than one thousand years' standing. What we claim as the real progress is a more efficient, because intelligent, use of their best features. The cause of their repeated failures in former ages was but a natural consequence of the state of general information, and mainly due to the want of suitable means for gaining a clear understanding of their respective methods of working. The intelligent farmer of the present day has greatly improved his chances by calling on the scientific investigators in every department of natural science to aid him in his varied and complicated field of labor. The best experimental resources of the present day have served of late as guides in drawing more correct deductions, and in arriving thus at more reliable results. To study the growth of our farm-plants under simple and well-defined circumstances, in the greenhouse and upon the experimental field, and to control the results thus obtained carefully in their various relations by means of the balance in the chemical laboratory, have greatly facilitated the discovery of more correct interpretations of facts than is possible under more complicated circumstances in the usual course of general farm operations. Leaving the improvement of farm-implements here out of consideration, we may safely assert that the main reasons of better results in agricultural operations, wherever carried on in a rational way, is due to a better knowledge regarding the relations of vegetable life to the soil, to the air, and to water, and the various reactions of these agencies upon each other, with an appreciation of the mutual dependency of animals and plants in the business of farming. Modern agriculture recognizes as its basis the necessity of a quick restitution to the soil of those substances which the crops raised have abstracted. To prove the existence of these relations, and teach how to comply with the requirements in each particular case, is the work of scientific investigators of the present generation. There is no opposition to any particular system of farm-management,—each farmer is left to choose an agricultural industry best adapted

to his natural and personal resources, yet all are restricted by one common rule: they have to comply with that unalterable relation which exists between demand and supply, since each plant, although in its own way, tends to exhaust the soil sooner or later.

The rapid and extensive introduction of the commercial mineral fertilizers is the best possible acknowledgment, although frequently unconsciously given, on the part of the practical farmer, regarding his belief in the usefulness of science in agriculture. The use of these concentrated fertilizers has fairly revolutionized this industry. They have proved, wherever judiciously applied, a most profitable investment. A new era may be dated from the day of their introduction, for the farmer finds his field of operations less restricted than formerly, and being more at liberty to choose his crops with reference to his markets, is able to make his avocation more remunerative. Their importance cannot be overestimated in regard to the maintenance of the fertility of our farm-lands, particularly as long as farmers still allow a fair portion of their home fertilizing material to waste, and as long as the sewage question of our centres of social life remains practically unsolved. Their special character in many instances favors specific modes of action, and thus renders them indispensable for the production of special crops for manufacturing purposes.

In the following pages I propose to present, first, a few considerations concerning fertilization with reference to the commercial fertilizers in general use; and, secondly, a short sketch of the recently introduced Stassfurt potash and magnesia fertilizers. In connection with these topics I shall also state the results of an analytical examination of a number of commercial fertilizers in use among the farmers of the State.

Stable-manure is still the main fertilizer in ordinary farm operations, yet its peculiar value rests to-day more on its beneficial influence on the physical condition of the soil than on its effect on its chemical composition. A few analytical statements concerning the composition of stable-manure under ordinary circumstances may give some idea of its usual chemical ingredients in various stages of disintegration.

One thousand pounds contained (Wolff) :—

	Water.	Organic substances.	Ash (total).	Nitrogen.	Potassa.	Soda.	Lime.	Magnesia.	Phos. acid.	Sulph. acid.	Silicic acid.	Chlorine.
When fresh, ...	710	246	44.1	4.5	5.2	1.5	5.7	1.4	2.1	1.2	12.5	1.5
" half decomposed, .	750	192	58.0	5.0	6.3	1.9	7.0	1.8	2.6	1.6	16.8	1.9
" more decayed, .	790	145	65.0	5.8	5.0	1.3	8.8	1.8	3.0	1.3	17.0	1.6

Finding ourselves at present better informed concerning the requirements of a complete manure, we know that stable-manure, although the most complex of our common fertilizers, can only in exceptional cases claim that title. As its composition depends mainly on the food consumed and the substance used as an absorber of the animal secretions, its commercial value varies widely, and its first cost depends on the price of the fodder consumed for its production. Wherever a farmer sells a portion of the produce of his industry, without replacing the ash-constituents of the articles sold, either in the form of food bought for his live-stock or its equivalent in the form of suitable fertilizers, he cannot prevent his stable-manure, for his system of operations, becoming by degrees an inefficient fertilizer, for it does not contain all the essential elements in such a proportion as his crops for a full repetition require. A change in fertilizers is equal to a change in the composition of the soil, particularly of that portion which alone is really valuable. The present condition of numerous farms in this and other countries is an unmistakable demonstration of this fact. The cultivation of meadow-lands, fallow, rotation of crops, superior mechanical preparation of the soil,—in fact, all those modes of treatment which aim at a suitable development of the latent natural resources of the soil,—can at best only more or less delay the time of its agricultural exhaustion; they cannot prevent that ultimate result. To rely on high farming, as a general rule, in procuring a sufficient supply of mineral plant-food from the natural disintegration of the soil, has proved to be unsafe. The commercial concentrated fertilizers, however, furnish excellent means to correct the composition of stable-manure, obtained under any system of agricultural industry, and to make it a complete fertilizer for the crops under cultivation. The kind of fertil-

izer which a farmer ought to buy is best learned from the article he sells. A few analytical statements bearing on this question may convey some idea about the amount and the kind of plant-food contained in 1,000 pounds of air-dried substance of some prominent articles of farm-produce :—

	Nitrogen.	Total ash.	Potassa.	Soda.	Lime.	Magnesia.	Phos. acid.	Sulph. acid.	Silicic acid.
Wheat grain,	20.8	17.7	5.5	0.6	0.6	2.2	8.2	0.4	0.3
Rye grain,	17.6	17.3	5.4	0.3	0.5	1.9	8.2	0.4	0.3
Barley grain,	15.2	21.8	4.8	0.6	0.5	1.8	7.2	0.5	5.9
Oat grain,	19.2	26.4	4.2	1.0	1.0	1.8	5.5	0.4	12.3
Corn grain,	16.0	12.3	3.3	0.2	0.3	1.8	5.5	0.1	0.3
Pease,	35.8	24.2	9.8	0.9	1.2	1.9	8.8	0.8	0.2
Beans,	40.8	29.6	12.0	0.2	1.5	2.0	11.6	1.5	0.4
Potatoes,	3.2	9.4	5.6	0.1	0.2	0.4	1.8	0.6	0.2
Common beet-roots,	1.8	8.0	4.3	1.2	0.4	0.4	0.8	0.3	0.2
Turnips,	1.8	7.5	3.0	0.8	0.8	0.3	1.0	1.1	0.2
Hay,	13.1	66.6	17.1	4.7	7.7	3.3	4.1	3.4	3.4
Live calf,	25.0	38.0	2.0	0.6	16.3	0.5	13.8	0.0	0.1
" oxen,	26.0	46.6	1.7	1.4	20.8	0.6	18.6	0.0	0.1
" sheep,	22.4	31.7	1.5	1.4	13.2	0.4	12.3	0.0	0.2
" pig,	20.0	21.6	1.8	0.2	9.2	0.4	8.8	0.0	0.0
Wool (washed),	94.4	10.3	1.9	0.3	2.5	0.6	0.3	0.0	0.3
Milk,	6.4	7.0	1.7	0.7	1.5	0.2	1.9	0.1	0.0
Cheese,	45.3	67.4	2.5	26.6	6.9	0.3	11.5	0.0	0.0
Eggs,	21.8	84.8	1.6	1.5	43.3	0.3	3.2	0.0	0.0

It must be quite obvious that information of the kind which these analyses convey may claim to be a safe guide when the question of restoring to the soil what has been abstracted comes under consideration. Upon large farms in Europe, it is quite customary to keep a book-account of the movements of the plant-food abstracted from the soil. The intelligent manager of a farm cannot fail to consider his prepared plant-food on hand as the capital he puts at interest; on its fair return depends his pecuniary success. Money judiciously expended in commercial fertilizers is known to pay well, and to manure liberally pays better than to manure scantily. It is a well-known fact, that wherever commercial fertilizers have been freely used as additions to stable-manure, the crops have been raised to twice what they were when only stable-manure has been depended on. England, and many other countries of

Europe, furnish the proof of this assertion. The farmer who wishes to benefit by the late rational progress in his occupation, ought to make himself somewhat familiar with the teachings of the previous analytical tables, and information of a similar character, for a disregard of this advice will surely leave him behind his more judicious neighbors. I call attention here to an observation which has been made quite generally in former times, as well as in the present generation, namely, that in the cultivation of grain-crops with the exclusive use of stable-manure, first, the grain has failed, and then the straw; and, in the case of high manuring, that the yield of grain declined and that of the straw increased, until, finally, the entire crop failed to be remunerative. Wheat first showed this peculiar tendency, and other farm-crops are affected more or less in the same manner. This singular fact has found its explanation in the influence which the universal practice of selling grain has on the soil employed for its production. A careful examination of the seeds of all our cereals has shown that they contain an immense proportion of phosphoric acid in comparison with the straw; for instance,—

Wheat grain,	0.82	per cent. phosphoric acid.
Wheat straw,	0.23	" " "
Indian corn,	0.55	" " "
" " stalks and leaves,	0.38	" " "

In selling the grain, from two-thirds to four-fifths of the phosphoric acid abstracted from the soil is lost for the next crop, and so year after year. When now we consider that this acid is but slowly rendered soluble by natural agencies, the first result cannot be doubtful. The straw will find for some time still its sufficient supply of phosphoric acid, but not enough for the formation of the grain. Continual demand, without an adequate supply, directly or indirectly, means exhaustion, even in the more favored localities. The general condition of most farm-lands regarding their present reduced store of active phosphoric acid alone accounts for the rapid and universal indorsement of phosphatic fertilizers,—as bones, superphosphates, &c.,—for it is contrary to the teachings of recent exact experimental inquiry to ascribe to phosphoric acid a particular virtue over any other of the essential articles of

plant-food,—as potassa, lime, magnesia, iron, sulphuric acid, carbonic acid, water, and some suitable nitrogen compound, as ammonia or nitric acid. Our information concerning the requirements for a full development of plants here become more concise. It has been proved by experiments, that the above named substances are not only essential, but of equal importance, which means, that in case one of them is wanting, the rest cannot act. The exact position of other elements, as sodium, silicium, chlorine, &c., which are frequently found in plant-ashes, is still less defined. Their functions, in case they have any in the vegetable economy, are still a matter of inquiry; but they are considered at present of secondary consequence. The observation in practice,—that of two crops which require the same essential soil-constituents, and in a similar obvious proportion, one fails where the other still yields a satisfactory return,—does not necessarily contradict the previous statement. A close examination in all instances of this kind will show that these plants live either upon a quite different stratum of soil, or their roots are by nature more or less better fitted to absorb to a larger degree the available plant-food,—they either have more numerous fine rootlets, or their roots spread over a larger space. The rate of absorption by the roots depends on the surface they present to the soil. We find it therefore quite natural, that conditions of lands exist where potatoes fail and beet-roots prosper, and also the reverse, or that barley and oats will for years prosper where wheat has failed, although in both instances a similar amount of the essential articles of mineral plant-food are required. The examination of the construction and the extension of the roots of our farm-plants has given most valuable suggestions in regard to a suitable system of rotation of crops.

The peculiar agricultural value of any fertilizer depends on the conditions of the soil under treatment, and that one of its constituents exerts the highest effect, which increases the amount of that ingredient which is most wanting in the soil for the support of the plant under cultivation. In some instances, it may be a suitable nitrogen compound; in others, phosphoric acid or potassa or lime, etc. The *agricultural* value of a fertilizer and its *commercial* value are measured by quite different standards,—the former is determined by the

judicious selection of the farmer, and the latter depends on the relation of demand and supply in the general market. The amount, and the relative proportion of the active plant-food in the soil, control the yield of the crops, provided the weather is the same. To secure the highest possible yield, under given circumstances, requires manuring to such a degree, that the plants find, at any given period of their growth, the largest amount of each article of plant-food they are capable of turning to account in their development. It is a noticeable fact, that plants quite frequently require, even of the same article of plant-food, a different quantity, in the various stages of their growth. It has been noticed, for instance, that the grain-crops consume an unusually large proportion of nitrogen during the period of blooming and forming the seed. In case the supply is not adequate to the periodical demand of the plants, their yield must suffer. It is for this reason in particular that a liberal manuring of farm-lands on rational principles pays better than to furnish but a meagre supply.

The present scientific views regarding the supply of atmospheric plant-food are not less explicit than those regarding the ash-constituents of plants. There is good reason to assume that all the carbon and the nitrogen which plants and animals contain is of atmospheric origin. Perfect plants may be raised from seeds in soil from which, by calcination, every organic and nitrogenous substance has been removed, by adding the ash-constituents of the plants to be raised, and by keeping the whole moist with rain-water. The nitrogen is supplied by the rain-water, in the form of ammonia and nitric acid. The atmosphere contains, for ordinary requirements, particularly for perennial plants, an ample supply of carbonic acid, water and ammonia, as appears in the growth of forests * and unmanured meadows. Yet, when the duration of the growing period becomes an important factor, as in the case of raising farm-crops, it is but natural to conclude that an artificial supply of atmospheric plant-food deserves the same attention as the supply of mineral plant-food, for any excess of the latter is of no value as long as a proper complement of the former does not render it active. To secure a luxuriant growth re-

* Hlubeck states the average annual growth of wood in the forests of Austria to be 1,500 pounds (= 32.33 cubic feet) per Prussian morgen, or 2,700 pounds on one acre.

quires, therefore, an artificial supply of atmospheric plant-food, and as decaying organic substances are continually producing carbonic acid, ammonia and water, the beneficial results arising from an incorporation of organic matter in the soil find a satisfactory explanation. The roots absorb the carbonic acid, water and ammonia from the soil, and this additional supply becomes of particular importance when the leaves of the plants are but little developed, or where they remain, from natural causes, of a small size, and are thus, in both cases, poorly qualified to absorb these substances freely from the air. Decaying organic matter acts, also, beneficially on the physical condition of the soil, and is a source of heat, in consequence of its gradual oxidation. As a liberal source of carbonic acid, it aids in the disintegration of the soil. By its highly carbonaceous character, it renders a light soil more retentive of moisture, and, if properly incorporated, by its own shrinking, heavy soils are made more porous. In spite of all these varied beneficial chemical and physical actions of the organic matter on the soil, no controlling importance is accorded to its presence, for, without its complement of mineral plant-food, its influence on the yield of crops can be but slight. The humus theory has had its day, and the nitrogen theory has followed suit. Experiments have proved that each fertilizing agent has its particular limit in promoting growth, and that a large accumulation of any one of them in the soil is, if not directly hurtful, at least bad economy.* The fact that phosphates sometimes, after years of liberal use, fail to produce the valuable results which had at first been noticed, is an illustration of the consequences of supplying fertilizers without due regard to the demand for them. From the foregoing statements, it must appear quite conclusive that concentrated commercial fertilizers deserve the particular attention of farmers, on account of their peculiar fitness to convert stable-manure into a complete fertilizer for any crop, and to produce thus by its use the highest possible yield from the lands under cultivation.

* Stockhardt, in experimenting with guano on potatoes, noticed that, in using 163 pounds of guano per acre, each pound of that fertilizer produced an increase of 25.2 pounds of potatoes; in using 340 pounds, but 12.2 pounds; in case of 520 pounds, bu 2.5 pounds; and in case of 695 pounds, but 1.75 pounds' increase of potatoes were obtained. Mr. Lawes' experiments with ammonia compounds, &c., gave similar results.

Artificial fertilizers, on account of their concentration and solubility, favor also a speedy enriching of the soil. To restore farm-lands, which have been reduced in their productiveness, to their original fertility, even when possible by means of stable-manure, requires some years of high manuring. The quality of the animal excretions, and the properties of the soil to be enriched, have each their specific influence on the result. Manure obtained from horses, or high-fed animals for instance, disintegrate more rapidly than that of cattle kept for ordinary purposes. Heavy and compact soils, being very retentive, require a larger amount of plant-food to thoroughly fertilize them than those which are less retentive, since its distribution is more restricted. Light soils, as sandy loam, &c., are well known to respond more quickly to manuring than heavy soils, and they are also more readily exhausted. A fair loamy soil gives the best returns with cencentrated fertilizers, and extremes of soil are, considered from an economical standpoint, unprofitable for high farming. As the farmer has to deal more or less with all kinds of soil, and in a varying state of productiveness, he finds himself often surrounded by most serious difficulties, in bringing his fields rapidly to their highest yield, when depending for fertilization on the exclusive use of his stable-manure, since the latter requires several years for its complete disintegration. A properly manufactured commercial fertilizer may frequently, in a shorter time, supply what is wanting to the soil, and its rapid distribution turn the latent plant-food at once to account, and thus secure, even the first year, remunerative crops. Well cultivated lands require, for the increase of their annual yield, but a small quantity of the fertilizing substance, provided the latter is in a state fit for immediate assimilation. Thus twelve to fifteen pounds of nitrogen and twenty to twenty-four pounds of phosphoric acid, ready for action, suffice in many instances per acre. Speedy distribution being thus one of the principal virtues of commercial fertilizers, it is right that the farmer should insist upon having such manures prepared with reference to that point. All concentrated fertilizers ought to be brought into a state of minute division, by mechanical or chemical means, as the circumstances may prescribe. Their comparatively high price renders it most desirable that the

investment, with interest, should be soon returned. Many of these artificial fertilizers have of late acquired, also, an additional value, on account of their special character, and thus special action on the quality of various important crops for industrial purposes. They have greatly aided to improve those qualities which impart to them a higher value. The improvements in the cultivation of sugar-beets, tobacco, &c., are of such an encouraging character, that much valuable information may be expected from experiments with other crops. Their importance in this direction will increase in the same proportion as we shall understand better the exact functions of each of the several mineral plant-constituents in regard to the various physiological processes going on in the growing plant. To study the peculiar influence of each article of plant-food on the production of vegetable substances, such as starch, sugar, oil, &c., has engaged for years the particular attention of agricultural chemists. When these questions are better understood, there is good reason to assume that a rotation in special fertilizers will ultimately serve, in a large degree, and very efficiently, as a substitute for the rotation of crops.

The recognition of the importance of various mineral substances in the economy of plant-life, has produced, as a natural result, the trade in fertilizers, and each new requirement of the farmer has been speedily supplied. Bone phosphates and superphosphates, the latter frequently mixed with nitrogenous animal matter or ammonia compounds, have formed hitherto the main bulk of commercial fertilizers. Phosphoric acid, lime, sulphuric acid and nitrogen have thus for years past been duly represented in the market, while potassa and magnesia have received less attention. The sources of potassa for fertilizing purposes formerly consisted mainly of nitre and wood-ashes. The former proved too expensive for agricultural use, and the latter were not available in sufficient quantity. The supply of magnesia was left entirely to the natural resources of the soil. The recent discovery of immense mineral deposits, containing both potassa and magnesia in a soluble form, has given a peculiar interest to extensive and systematic agricultural experiments, by which their great value has been abundantly demonstrated. I propose, therefore, to treat of these

new fertilizers, which are known in commerce by the name of Stassfurt salts, somewhat more in detail in another part of this Report.

The great interest which the farmers of the State must feel to learn what they are buying, and whether they are getting the value of their money, has induced me to make myself somewhat familiar with the character of some of these fertilizers which enter our markets. The samples have been taken from barrels bought in their respective depots in our vicinity, and had their proper brands, and, at the same time, the required printed statements concerning their chemical composition. As the farmer does not propose to pay for anything but phosphoric acid, nitrogen (or ammonia) and potassa, I give my analytical results with particular reference to these substances. The valuation of these articles has been made in conformity with the prices of late recognized by dealers and consumers in our section of the country. These prices are 16.25 cents for each pound of soluble phosphoric acid, 13.2 cents for every pound of reduced phosphoric acid, six cents for every pound of insoluble phosphoric acid, thirty cents for each pound of nitrogen and eight cents for each pound of potassa. Reduced phosphoric acid is that portion which has apparently once been rendered soluble in water, but has become insoluble again in consequence of peculiar reactions which sometimes occur in the manufactured fertilizer. Its compound with lime is soluble in citrate of ammonia, and in a suitable condition for speedy absorption under the influence of the carbonic acid of the soil.

I.

AMMONIATED BONE SUPERPHOSPHATE OF LIME, MANUFACTURED BY RUSSELL & CO.

Moisture and volatile matter,	61.54	per cent.
Non-volatile matter,	38.46	"
Soluble phosphoric acid,	10.55	"
Reduced " "	2.14	"
Insoluble " "	2.46	"
Nitrogen (= 2.5 ammonia),	2.02	"

Valuation per ton of 2,000 *pounds.*

211.0 pounds of soluble phosphoric acid,	$34 24
42.8 " of reduced " "	5 60
49.2 " of insoluble " "	2 95
40.4 " of nitrogen (50.0 lbs. of ammonia),	12 12
	$54 91

II.

W. L. Bradley's XL Fertilizer.

Moisture and volatile matter,	52.11 per cent.
Non-volatile matter,	47.89 "
Soluble phosphoric acid,	6.45 "
Reduced " "	2.83 "
Insoluble " "	3.60 "
Nitrogen (3.23 ammonia),	2.43 "

Valuation per ton of 2,000 *pounds.*

129.0 pounds of soluble phosphoric acid,	$20 96
56.6 " of reduced " "	7 47
72.0 " of insoluble " "	4 32
48.6 " of nitrogen (64.6 ammonia),	14 58
	$47 33

III.

Wilson's Ammoniated Superphosphate of Lime.

Moisture and volatile matter,	50.95 per cent.
Non-volatile matter,	49.05 "
Soluble phosphoric acid,	6.65 "
Reduced " "	1.01 "
Insoluble " "	0.93 "
Nitrogen (3.42 ammonia),	2.82 "

Valuation per ton of 2,000 *pounds.*

133.0 pounds of soluble phosphoric acid,	$21 51
20.2 " of reduced " "	2 66
18.6 " of insoluble " "	1 12
56.4 " of nitrogen (68.4 ammonia),	16 80
	$42 09

IV.

Quinnipiac Soluble Nitrogenous Phosphate.

Moisture and volatile matter,	55.51 per cent
Non-volatile matter,	44.49 "
Soluble phosphoric acid,	5.50 "
Reduced " "	2.45 "
Insoluble " "	3.47 "
Nitrogen (3.14 ammonia),	2.59 "

Valuation per ton of 2,000 *pounds.*

110.0 pounds of soluble phosphoric acid,	$19 87
49.0 " of reduced " "	6 67
79.4 " of insoluble " "	4 76
51.8 " of nitrogen (62.8 ammonia),	15 54
	$46 74

V.

FALE'S FERTILIZER.

Moisture and volatile matter,	39.87 per cent.
Non-volatile matter,	60.13 "
Soluble phosphoric acid,	1.50 "
Reduced " "	2.49 "
Insoluble " "	4.06 "
Nitrogen (3.23 ammonia),	2.66 "

Valuation per ton of 2,000 *pounds.*

30.00 pounds of soluble phosphoric acid,	$4 88
49.80 " of reduced " "	6 57
81.20 " of insoluble " "	4 87
53.20 " of nitrogen (64.6 ammonia),	15 96
	$32 28

VI.

GUANO (GUANAPE ISLANDS).

Moisture and volatile matter,	57.38	54.17	54.98
Non-volatile matter,	42.62	45.83	45.02
Sand,	10.94	12.47	13.10
Total phosphoric acid,	11.59	12.08	11.25
Nitrogen (11.78 ammonia),		9.70	
Potassa,		2.02	

Valuation per ton of 2,000 *pounds.*

238.80 pounds of phosphoric acid (at 12.64 cents per pound),	$30 18
194.00 " of nitrogen (235.60 ammonia),	58 20
40.40 " of potassa,	3 23
	$91 61

I present these analytical results and valuations without any farther comment. They tell plainly whether the amount asked for these fertilizers in the various sections of the State is a reasonable one. The guano, although inferior to the average Peruvian guano, is, it appears, still the cheapest ammoniated phosphate in our market. There are several important points in the fertilizer trade which require the serious attention of the farmer. The present condition of that trade leaves the farmer too much in the hands of the dealers, and places at the same time the honest dealer at a great disadvantage with his less scrupulous competitors in the business. To obviate this, it appears to be but right that certain provisions for the regulation of the trade in commercial fertilizers should be made. Every dealer in these articles should be obliged to

accompany each package of his manure which enters the market with a distinct statement, giving the exact quantity of each ingredient which imparts a special commercial value to the fertilizer, and fraud in the manufacture should be a criminal offence, with a penalty proportionate to the damage done to the agricultural community. Allowances should be made, of course, concerning such alterations as time may cause, or as are unavoidably connected with the ordinary modes of manufacture on a large scale. In case judicious laws bearing on these questions should not be found expedient by those in authority, it would be well for the farmers to associate for their own protection, and to refuse to buy of any dealer who does not comply with their just demands. Differences arising between the dealer and the consumer could be decided by a chemical analysis. The chemist charged with the examination should be obliged to carry out the analysis according to some well-established mode, and to state his results in such a manner that every farmer could decide for himself whether he got the value of his money or not. The man who believes that he can judge correctly of the value of an artificial fertilizer by any casual examination, except as to its mechanical conditions, deceives himself. An abominable or peculiar odor is not necessarily an attribute of fertilizing substances. The pecuniary valuation of the various constituents of commercial manures should also be more generally decided with reference to their fitness for immediate re-action, for a speedy effect is one of their principal recommendations. Their respective agricultural values, on account of their special character, are greatly dependent on the rapidity with which they render other latent plant-food in the soil active. The price of insoluble phosphoric acid is based on the price of bone-meal, and that of ammonia ought to be based on that of crude sulphate of ammonia. Bones and sulphate of ammonia are largely used in different branches of chemical industry. The outside demand controls their prices, and farmers cannot complain when they are asked to pay what everybody else has to pay. To apply, however, these prices indiscriminately to phosphoric acid and to nitrogen in every other form, may suit the dealer, yet cannot be considered a fair practice by the farmer. As far as the soluble phosphoric acid is concerned, it matters but little from what source it has

been obtained; yet it is of considerable importance to know whether the insoluble phosphoric acid is present in the form of Peruvian guano, steamed bone-dust, fish guano or poudrette,—or in the form of coarse-ground bones, South Carolina, Baker's, Jarvis's or Sombrero phosphate, or refuse boneblack from sugar-refineries, or pulverized apatite. The substances first named are known to act as quickly, if not more so, than stable-manure, while those last named act much slower. The substances of the second group above mentioned, ought not to be to any extent in their undecomposed state in any artificial concentrated phosphatic fertilizer. Their usefulness in their natural condition depends entirely on their minute mechanical division, and they ought to be furnished in a finely pulverized form, and each at its own commercial value. They should then be mixed with stable-manure, or a compost, where a steady supply of carbonic acid might prepare them most advantageously for future assimilation. As it is quite troublesome to distinguish in any commercial compound fertilizer the peculiar source of the insoluble phosphoric acid, the safest practice for the farmer is not to buy so-called superphosphates which contain insoluble phosphoric acid beyond a few per cent., unless due allowance is made in the price.

In regard to the valuation of nitrogen, a distinction has been made by chemists between actual and potential ammonia, meaning by actual ammonia that portion of nitrogen in a fertilizer which is already present in the soluble form, as some nitrate or ammonia compound. The name potential ammonia refers to that portion of the nitrogen which will be changed sooner or later, under suitable circumstances, into ammonia. The value of actual ammonia is, as already stated, best estimated from its cost in the form of crude commercial sulphate of ammonia. This compound is obtained in gas-works, and in connection with the destructive distillation of animal matter, as in the manufacture of boneblack. To estimate its value from its cost in guano seems to be more objectionable, as its price in that case depends largely on the value we assign to the phosphoric acid present. The valuation of nitrogen, in the form of potential ammonia, should be somewhat restricted, as in the case of insoluble phosphoric acid. From the fact that a classification of substances, which are

considered sources of potential ammonia, must be necessarily somewhat arbitrary, it does not follow that we ought to discard entirely a proper lower value of potential ammonia as compared with actual ammonia, or that we ought not to discriminate between the various nitrogenous materials which may be used. Urates, blood, dried meat, steamed bone-meal, fish guano and poudrette, form ammonia with much readiness, excelling even stable-manure in this respect. On the other hand, refuse wool, leather, hair, horn-shavings, &c., are all much more slowly decomposed, and therefore require to be composted in a suitable mechanical form. These substances are, of course, valuable for agricultural purposes; but as a considerable period of time is required before their full benefit will be enjoyed, their price ought to be made with reference to the loss of interest on the investment. The practice of incorporating these substances into artificial fertilizers, without a previous proper disintegration, exposes the farmer, not only to frequent disappointments in regard to his crops, but to serious pecuniary losses.

Having named some things concerning commercial manures, about which farmers and agricultural chemists ought to consult for the *general* good of agriculture, I take the liberty of advising all persons to be cautious in indorsing this or that fertilizer. It should be enough for the buyer to certify that the dealer furnished him the substances which his bill specifies. To give him the entire credit of success, or to blame him in regard to the results obtained, is, as a general rule, unfair; for, as the various articles of plant-food act always in the same direction, and as they can only produce an increase of yield when they are needed, it is the good judgment of the farmer which deserves the credit in case his crops increase under his management, and at his own door rests the blame of his failures. Moreover, it not unfrequently takes years of systematic fertilization to show the beneficial influence of fertilizers upon exhausted lands. The best phosphates in the world will not improve the fertility of lands when potassa is wanting, and the richest ammonia compound will be without any effect in case a sufficient amount of ammonia is already present. The real money value of any fertilizer cannot be directly determined by the mere consideration of the results

obtained at any particular time, and it is also evident that the condition in which a manure leaves the soil, after one crop has been raised, is a most important factor in deciding upon its entire agricultural worth.

II.

The Stassfurt Potash and Magnesia Fertilizers.

In a paper read before the Massachusetts Board of Agriculture, in December, 1869, I alluded to the growing importance of the Stassfurt manure-salts. Numerous experiments, made by qualified parties in Germany, France and England, leave at present no doubt about their great value as fertilizers. They have, also, of late been introduced into our markets, and as they supply a special want among our commercial concentrated fertilizers, and are thus destined to acquire considerable importance, it seems proper to make the farmers of the State more familiar with their character, and with the existing experimental results concerning their peculiar adaptation for agricultural purposes. These salts were first discovered at Stassfurt, Prussia, in connection with an extensive rock-salt deposit. In sinking a shaft to the depth of 1,066 feet, a peculiar layer of various saline compounds, 158 feet in thickness, was penetrated, which directly overlaid the rock-salt. This surface deposit seemed to consist of all the more soluble compounds, but slightly altered, of the oceanic waters, from which the entire deposit originated.* As a source of salt for ordinary domestic purposes, it was considered unfit, and, consequently, whatever had to be removed to get at the underlying rock-salt was drawn aside as worthless. The celebrated analytical chemist, H. Rose, subsequently called attention to this refuse mass as a source of potassa compounds. The government soon acted upon his suggestion, and caused, in 1860, sales at low rates, offering at the same time premiums to those parties who should succeed in inventing some suitable mode by which they might be changed into more valuable compounds for industrial purposes. The present extensive chemical industry at Stassfurt, and in its vicinity, is the outgrowth of that movement. The production of potassa amounted, in

* For details, see my paper "On Stassfurt Potash and Magnesia Salts, &c.," in "American Chemist," July, 1871, page 5.

1867, to 24,000,000 pounds, and the entire capacity of the Stassfurt mines, as far as explored at that time, promised to be from 100 to 120 millions of pounds per annum for 100 years to come. The influence of this new source of potash compounds on the general market of these articles, may be inferred from the fact that, in 1863, the entire annual supply of potash compounds for industrial purposes consisted of 8,000,000 pounds of chloride of potassium, 40,400,000 pounds of nitrate of potassa, and 65,200,000 pounds of carbonate of potassa,*—in all, 113,600,000 pounds. Agriculturists were among the first to avail themselves of the cheap crude refuse salt for fertilizing purposes, yet they met, as a general rule, with but little success in their experiments. A comparison of the results of chemical analyses soon established the fact that the material used in the various experiments must have differed widely in its composition. This difference in composition found its explanation in the peculiar arrangement of the various salts in nature. They occurred in successive layers, and their quality depended entirely on the locality whence they had been taken. The following figures convey some idea of the variations noticed in the composition of the crude Stassfurt manure-salt used in many of the early experiments (Heiden) :—

Cloride of magnesium,	from	12.20	to	31.19	per cent.
" sodium,	"	2.69	"	57.20	"
" potassium,	"	0.00	"	14.49	"
Sulphate of soda,	"	1.90	"	17.21	"
" potassa,	"	2.00	"	19.21	"
" lime,	"	0.00	"	19.10	"
Carbonate of lime,	"	0.00	"	4.40	"
Borate of magnesia,	"	0.00	"	4.01	"

These analytical results render it quite obvious how little reliance could be placed on experimental results obtained by the use of a substance liable to vary so widely in its constitu-

* The carbonate of potassa was obtained from the following sources :—

Russia,	18,200,000 pounds.
North America,	13,500,000 "
Hungary,	10,300,000 "
From refuse material in the beet-sugar manufactories of Europe,	23,200,000 "
	65,200,000 pounds.

ents, as well as in their relative percentage. Farmers, consequently, discontinued their use, and thereby compelled the dealers in these fertilizers to exert themselves to produce a more reliable material. The consequence has been, that at present there is scarcely a Stassfurt potassa fertilizer in the market which is not the result of some process of concentration. As a good illustration of what is at present offered for sale at Stassfurt for agricultural purposes, we may refer to a late price-list of one of the largest manufacturing companies of these fertilizers. One of the managers of this company is the most successful inventor of new modes of manufacture in this branch of industry, Dr. Grüneberg. The following price-list was published January, 1872, and the price is based upon a value of seventy-two cents, gold, for one Prussian thaler at Stassfurt, the salt being sold in bulk:—

	Percentage of oxide of pot'ssium.	Price p'r 100 lbs. of the fertilizer.	Price of one lb. of oxide pot'ssium.
1. Potash fertilizer, ground, containing from 16 to 22 per cent. of sulphate of potassa, with more or less of chloride of sodium, to suit the customer, ...	9.11	$0 36	$0 3.5
2. Concentrated potash fertilizer, containing, .	25.00	1 26	0 5.0
3. Sulphate of potassa and magnesia fertilizer (or artificial kainite), containing from 28 to 30 per cent. of sulphate of potassa, . .	15.18	0 60	0 4.0
4. Concentrated sulphate of potassa, equal to from 78 to 80 per cent., ...	43.44	3 36	0 7.8
5. Concentrated chloride of potassium (No. 5), containing 80 to 85 per cent., . . .	50.53	2 64	0 5.0
6. Sulphate of potassa and magnesium, with 52 to 56 per cent. of sulphate of potassa and 30 to 38 per cent. of sulphate of magnesia,	28.3	2 64	0 7.8
7. Sulphate of magnesia, equal to 60 per cent. of sulphate of magnesia, ...	0.0	0 36	0 0.0
8. Sulphate of potassa (about 11 per cent.), with a large percentage of magnesia for scattering over stable-manure and compost heaps,	5.8	0 24	0 4.1

We learn from the foregoing figures that the oxide of potassium costs less per pound in the lower grades (1, 3, 8) of these compounds than in the higher ones (2, 4, 6), and also that it costs less in the higher grades of chloride of potassium than in that of the sulphate of potassa (4, 5). The cheapness of the lower grades is considerably reduced by an

increase of freights for less valuable articles;—as soon as the freight for one hundred pounds of oxide of potassium exceeds about sixty cents, gold, the higher grades become cheaper material for use. With us, considering the cost of freight, the higher grades are decidedly preferable. I have made an analysis of various samples of Stassfurt fertilizers. The following statements may convey some idea of what has been offered for sale in our own markets during the past few years:—

1. Concentrated sulphate of potassa, represented to contain 90 per cent. I found	87.72	per cent.
2. Chloride of potassium, represented at 90 per cent. I found	89.02	"
3. Refined sulphate of potassa and magnesia:		
Sulphate of potassa, ...	43.3	"
" of magnesia, ...	33.1	"
" of lime, ...	2.2	"
4. Concentrated sulphate of potassa, equal to 22.87 oxide of potassium, ...	42.0	"
5. Calcined (rough ground) sulphate of potassa and magnesia:		
Sulphate of potassa, ...	19.90	"
" of magnesia, ...	17.50	"
Basic chloride of magnesium, ...	4.60	"
Sulphate of lime, ...	4.20	"
6. Artificial kainite:		
Sulphate of potassa, ...	27.60	"
" of magnesia, ...	18.18	"
" of lime, ...	5.20	"
Chloride of sodium, } not determined.		
" of magnesium, }		
7. Calcined native sulphate of magnesia (= kieserite):		
Sulphuric acid, ...	52.29	"
Magnesia, ...	25.31	"
Lime, ...	6.59	"
8. Native sulphate of magnesia (= kieserite):		
Sulphuric acid, ...	39.98	"
Magnesia, ...	17.86	"
Lime, ...	4.86	"

The unsatisfactory results at first obtained with the crude

salts discouraged, as before stated, their consumption in general agricultural operations, yet it did not affect the opinion of those parties who believed in the fair prospect and great importance of an additional abundant and cheap source of potash compounds for agricultural purposes. They continued experimenting under more defined, and thus more favorable, circumstances. The question before scientific investigators was not whether a potash fertilizer would be useful for agricultural purposes, for there was scarcely an ordinary rotation of crops on record in which the demand for potassa did not exceed that of any other plant-food, phosphoric acid frequently not excepted,* provided stock-fattening is not a prominent feature of the agricultural system adopted. Some of the most important commercial farm-crops, as potatoes, beet-roots, hops, tobacco, corn, &c., are known to require a large quantity of potash; while the most prominent potassa-containing rocks, as potassa, feldspar, &c., disintegrate very slowly, and thus can furnish the potassa but sparingly. A few detailed statements may convey some definite idea regarding the consumption of potassa by most agricultural crops (Birnbaum) :—

Grain crops abstract per acre, about	23.70	pounds.
Meadows and pastures, "	56.88	"
Most garden vegetables and hoed crops, about	111.60	"
Clover and other fodder crops, about	63.20	"
Commercial plants, about	79.00	"
Grape-vines, "	63.20	"

Cordee asserts that sugar-beets in Austria abstract annually from the soil 17,300,000 pounds of potassa, in France about twice as much, and in the German Confederation 38,900,000 pounds, and that potatoes abstract in Old Prussia, without counting stems and leaves, 84,000,000 pounds from the lands under cultivation with that crop.

Taking the utmost economy for granted, there is scarcely any reason to doubt that in very many instances an application

* Prof. Birnbaum, in calculating the average consumption of soil constituents of fourteen different systems of rotation, allowing the usual complement of live-stock, finds that for a medium production every acre requires an additional annual supply of 17.4 pounds of potassa, 6.4 pounds of magnesia, 11.0 pounds of lime, 14.2 pounds of phosphoric acid in case stable-manure is the fertilizer.

of potash fertilizer will be as beneficial as phosphatic fertilizers have proved. Farmers who have been in the habit of suffering their liquid manure to waste have particular reason to try potash fertilizers upon their lands. Numerous experiments manifestly show that the majority of farm-lands, which have been for any length of time under cultivation, are in such a state of exhaustion that an addition of phosphoric acid and potassa produces larger crops than either one of these fertilizers alone, and that potassa, phosphoric acid and some suitable nitrogen compound will act still better than either two of them alone. It is for this reason that those who have no clear idea about the specific action of each crop upon the soil usually get along better with compound manures,—as stable-manure, ashes and oil-cake,—than with special fertilizers, yet they rarely obtain a maximum yield, nor can they expect to engage successfully in the production of special crops of a superior character. These compound manures acquire, in fact, a particular importance, when we consider their composition with reference to the crop to be raised by their aid. The idea that we can produce large crops of all kinds of plants by adding a little of everything, finds no support in the past experience of high or special farming. The farmer, who wishes to cultivate his lands most profitably, must qualify himself to comply with the special demands of his crops.

The main point in regard to the potash fertilizers, which required exact investigation, was to learn, by actual experiment, in what particular form the Stassfurt potash compounds would act best,—whether as chloride or as sulphate,—and what peculiar effect those compounds exert which accompany the potassa in either of these two forms. The results thus far obtained may be summed up as follows: the sulphate of potassa is unanimously indorsed as the safest potash compound, without regard to the kind of crop, particularly as far as the quality of any product is concerned. According to Stöckhardt, it increases the percentage of starch in potatoes. Karmrodt and Stohmann found that it increased the sugar in the sugar-beet. Schlossing and Nessler noticed that it counteracted best, in common with nitrate of potassa, the tendency of tobacco to char, and thus to smell offensively, thereby rendering it better adapted for smoking, and increasing thus its

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commercial value. Upon wet lands alone is its use decidedly unprofitable. Even Sir Humphrey Davy noticed this fact. The chloride of potassium has not received such general commendation, and its use as a fertilizer for potatoes and tobacco has been decidedly discouraged, for it acts upon these crops, more to increase the quantity than to improve the quality. It is, however, highly recommended for meadow and pasture lands, for all kinds of forage crops and grain crops, particularly when applied in connection with superphosphates. The chloride of potassium is also specially suited for use upon wet lands, and in case of very retentive, heavy soil. The efficiency of any potash fertilizer can, of course, show itself only when an additional supply is needed; yet even in case of a deficiency in the soil, its effect may be greatly influenced by the condition of the same. If it is too retentive, the circulation of the salt will be limited, and, if not retentive enough, it will descend too quickly to the subsoil.

As long as the matter of absorption was but little understood, many observations with potash fertilizers could be scarcely reconciled with each other, and their merits remained doubtful. The peculiar absorptive properties of a good agricultural soil, which Way and Thompson first noticed, has been more studied, and additional facts have been established within later years, which enable us to control better the physical condition of the soil regarding the distribution of an article of plant-food like potassa, phosphoric acid, &c. We have learned that the property of absorbing these substances belongs mainly to the fine, clayish silt in the soil, and to a sufficient amount of humus well distributed throughout the entire earthy material under agricultural treatment. As both these conditions of the soil are the natural consequence of a proper cultivation, we find it not surprising that the improved portion of the same kind of soil possesses higher absorptive powers than the uncultivated one. The phenomenon of absorption appears to be but another name for replacement, since it has been noticed that absorption of potassa takes place only when compounds of soda, lime and magnesia are present, while a corresponding amount of the latter is always set free, and passes into the subsoil waters. In case these substances are wanting, or are only present in a small quantity, or in a form not suit-

able for exchange, the absorption does not occur, and consequently the action of the fertilizer becomes uncertain. The discovery of chemical means to aid in the distribution of phosphoric acid by Liebig, has been of late followed by the recognition of means to promote the distribution of potassa throughout the entire bulk of the soil under cultivation. Foremost among these means are chloride of sodium (Frank) and sulphate of magnesia (Pinous). The beneficial effect of common salt as a fertilizer is doubtless often the result of this fact.

Some of these Stassfurt fertilizers deserve particular attention on account of a large percentage of sulphate of magnesia, and, in some instances, more or less of chloride of magnesium. The latter compound is, even in small quantities, directly hurtful to vegetation, and no fertilizer should contain it to any extent. Calcined potash compounds are usually free from it. Magnesia compounds, as a general rule, are in their isolated condition objectionable for fertilization, yet in presence of potassa or soda compounds they seem to be harmless. The sulphate of magnesia has for two reasons acquired considerable value in agricultural operations,—it may be used as an absorber of ammonia and phosphoric acid, and aid in the distribution of potassa in the soil. As a means for the distribution of potassa, it is known to exceed every other which has been applied for that purpose. Fertilizer No. 6, consisting of 52–56 per cent. of sulphate of potassa and 30–38 per cent. of sulphate of magnesia, enjoys a particular reputation on account of its superior fitness to cure clover-sick and beet-sick lands, the potassa passing rapidly to the lower strata of soil, and coming thus in direct contact with the roots of these plants. The sulphate of magnesia may be used like gypsum, and, if scattered over stable-manure, or composted with it, absorbs ammonia, and combines with the soluble phosphoric acid, while, on account of its greater solubility, it exceeds gypsum in efficiency. As magnesia is one of the most essential articles of plant-food, it is natural that a direct incorporation of it in the main fertilizer may produce beneficial results. The peculiar saline character of these Stassfurt fertilizers renders it advisable to apply them with some special precaution. In their isolated state, they injure the roots with which they come in direct contact, and

they are, therefore, best either scattered daily in small quantities, or composted. These modes of application are undoubtedly most advisable in general farming. In case they are to be used for special crops for commercial purposes, they ought to be mixed thoroughly with three or four times their weight of muck or loam, and then carefully used with reference to the object in view. The best time for application is late in fall or early in spring, to allow their suitable distribution in the soil. In case of a loose, sandy or gravelly soil, where spring manuring pays best on account of a low degree of absorption, it is best to incorporate them but a short time before planting. Their continued systematic use is only to be recommended upon well-drained lands.

REPORT OF JOHN C. DILLON,

FARM SUPERINTENDENT.

REPORT.

President W. S. Clark.

Sir :—I have the honor to submit my Report of farm operations during the past year.

The areas of land devoted to the different crops are as follows :—

	Acres.	Rods.
Potatoes,	4	0
Sugar-beets,	4	0
Corn,	8	47
Swedish turnips,	0	90
Rye,	4	80
Barley,	2	80
Oats,	11	3
Millet,	1	0
Fodder-corn,	1	0
" oats,	1	80
Strawberries,	0	58
Small fruits,	0	110
Nursery,	1	120
Vegetable-garden,	1	151
Young apple, pear and peach orchard,	3	0
Vineyard,	2	0
Total area in tillage,	48	19
Pasture,	126	47
Old apple-orchards,	3	0
Mowing,	125	110
Woods and roads,	80	64
	383	80

The potatoes were planted on land which was well manured and produced a good crop of corn last year, and I planted it again to subdue a kind of sedge-grass, which had taken complete possession of the soil. The land was ploughed April

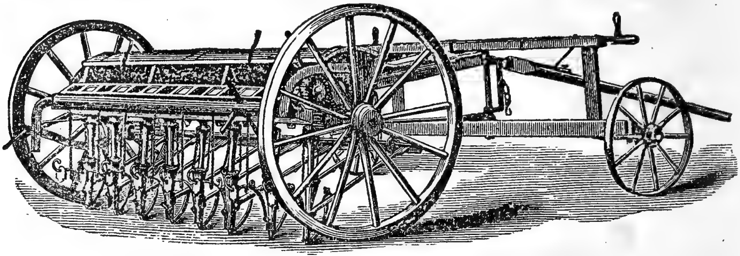
26th, seven inches deep, and harrowed with the Nishwitz harrow. April 29th to May 4th, it was furrowed out five inches deep and two feet six inches apart, and halves of potatoes, planting size, were dropped in the furrows at intervals of eighteen inches in the rows. The piece was then harrowed lengthwise the furrow with Thomas's smoothing-harrow, which covered without disturbing the sets. This harrowing did not quite fill up the furrows; but another passage of the same implement, about a week later, left the ground as smooth as a garden-bed, and also destroyed a myriad of weeds which had begun to germinate. The land was harrowed again, just as soon as we could see the rows. The 17th of June, we ran a double mould-board plough between the rows, which raised a ridge of earth on each side of the plants, and the smoothing-harrow following, sifted the thoroughly pulverized soil among the plants, made handsome rounded ridges, and left the field in better shape than it could possibly have been done by hand.

The land where the potatoes grew is a sandy loam, in an elevated position, and with a considerable slope toward the valley,—not by any means the kind of land that would be commonly expected to need draining. The presence of stagnant water is, however, indicated by the grasses alluded to, and also by the presence of wire-worms in great numbers. These larvæ seriously diminished the crop, destroying and damaging the young plants, and, by perforating the tubers, rendered a considerable number of them fit only for fodder. The actual yield was five hundred and ten bushels of large potatoes and ninety-six bushels of small. Of the large, about four hundred bushels, all in fact that were not injured by the wire-worm, were of first-rate quality. The kinds planted were the Orono, the Early Rose, King of the Earlies, Peerless, Brezee's Prolific, and Brigham's Seedling. Some interesting points of difference were observed in the growth and yield of the different varieties; but the ravages of the wire-worm prevented any precise comparison of the respective merits of the several kinds.

The machinery for the cultivation of the beet-crop, which was ordered from Germany in January last, was delayed by adverse winds, and afterwards detained in the custom-house for payment of duty. The matter being properly represented,

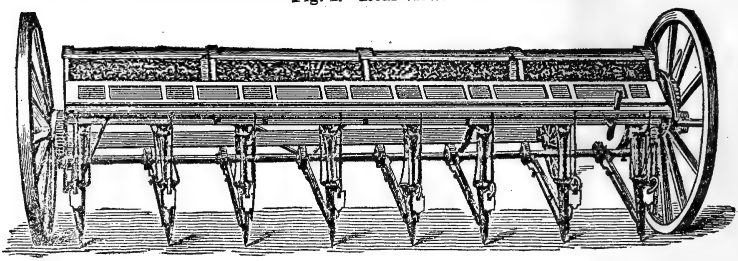
the machinery was admitted duty free; but, through an accident on the railroad, it was still further delayed, and did not reach Amherst till the 21st of May. Getting the machinery from the depot, setting it up, studying its construction and experimenting with it on the barn-floor in the midst of pressing spring work, and the final preparation of the land, occupied some time, and it was not till the 24th of May we were able to plant the beet-seed. As I shall have to refer to these implements again, I annex drawings and descriptions :—

Fig. 1. Side view.



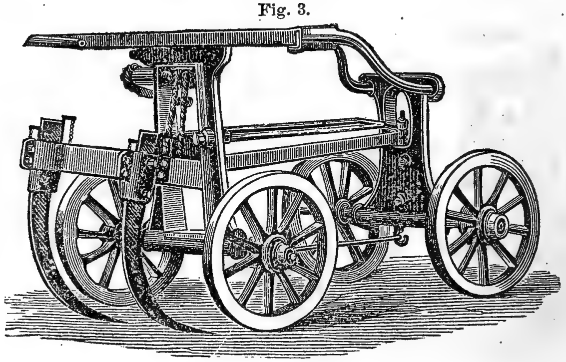
THE GERMANIA BEET-PLANTER.

Fig. 2. Rear view.



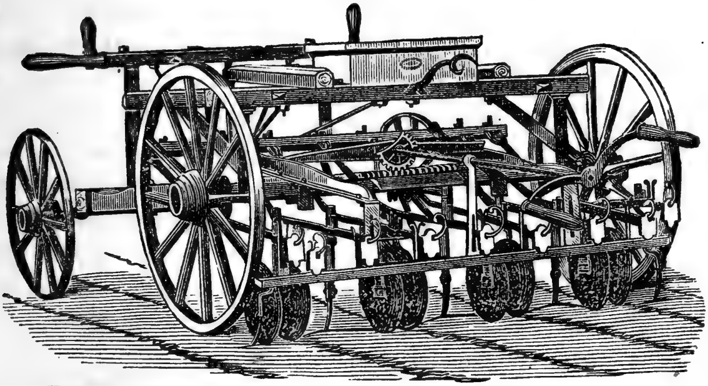
THE GERMANIA BEET-PLANTER.

Fig. 3.



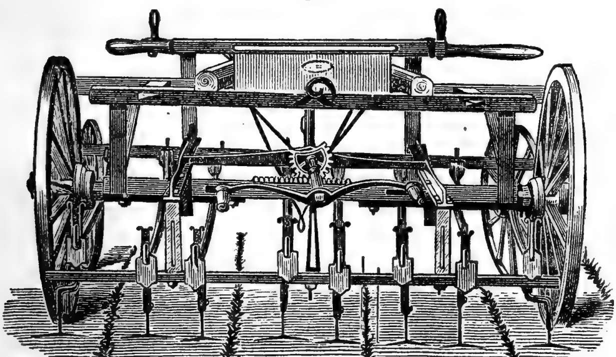
THE BEET-DIGGER.

Fig. 4.



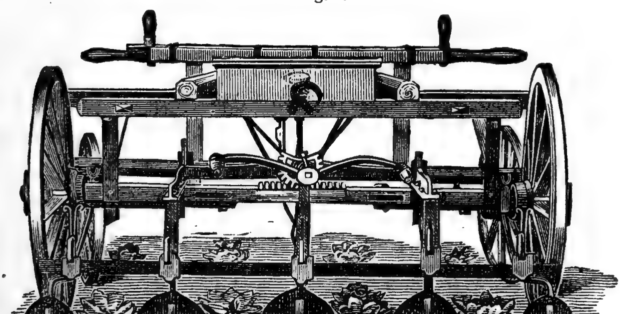
THE BEET-CULTIVATOR, with attachment for protecting the young plants.

Fig. 5.



THE BEET-CULTIVATOR, arranged for ordinary work in destroying weeds.

Fig. 6.



THE BEET-CULTIVATOR, with attachment for covering the roots at the last hoeing.

THE BEET-PLANTER. (Figs. 1 and 2.)

The Dibble-machine, or beet-planter, weighs 1,350 pounds, is drawn by two horses, and plants eight rows, eighteen inches apart, at each passage.

The seed is placed in hoppers, extending along the top of the machine. Hence it descends through shutes or apertures, which can be enlarged or contracted at pleasure, into the body of the machine. A shaft, furnished with small spoons, runs through the body of the machine and is made to revolve with greater or less rapidity by an arrangement of cog-wheels, connecting the shaft with one of the driving-wheels. At each revolution of the shaft each little spoon brings up a seed and deposits it in a small hopper, from which it descends through a series of funnel-shaped tubes, which telescope into each other, into the seed-box in the drill.

Another series of cog-wheels is set in motion by the other driving-wheel and these cause another shaft to revolve, faster or slower, according to the arrangement of the wheels. This shaft is furnished with eight wheels, with cams or projections on their circumference, which operate the valve-rods which open and shut the seed-boxes in the drills, and thus this gearing regulates the distance at which the seeds are dropped, just as the other regulates the quantity of seed deposited in the seed-boxes. The seed-drills are furnished with little ploughs which open furrows for the seed, deeper or shallower in proportion as they are laden with weights provided for the purpose, and, being hung on pivots, they readily adapt themselves to any inequalities on the surface of the land. In returning, the inner wheel follows in the track made by the outer one in going; and thus the last, and every other row of a twenty-acre field, is parallel with the first, and each row is equidistant from the next preceding one. On the College beet-field, the rows were 232 yards long, and the time occupied in making one passage was three minutes forty seconds; it was found, however, that, including two turnings, the time required to go and return, planting sixteen rows, averaged eleven minutes. The rows being eighteen inches apart, an acre contained forty-two rows and was planted in twenty-eight minutes fifty-two seconds. With land thoroughly

prepared, and with men and horses practised in their work, there would be a considerable saving of time, and the machine would probably plant twenty-five to thirty acres per day, as claimed by the manufacturer.

The Beet-Cultivator. (Figs. 4, 5 and 6.)

This machine is also drawn by two horses and cultivates five rows at each passage. It consists mainly of five sets of scuffles or hoes, for use in a frame-work, suspended between the hind wheels of the machine. By means of a lever, terminating in a cog-wheel and playing on a cogged semicircle, this frame can be moved from side to side, or elevated to pass over obstructions, or for convenience in going to and returning from the field. Each set of hoes comprises three different forms of implements, adapted to the cultivation of the crop at different stages of its growth. The first set consists of a broad single scuffle, almost as wide as the distance between the rows. This is intended to be used about as soon as the rows can be traced, and it is provided with a contrivance which bestrides the rows and protects the young plants from being covered with earth. The second set of implements consists of two narrower scuffles, which penetrate and stir the soil to a greater depth, and are used after the plants have grown stronger and there is no longer any danger of covering them with earth. The third set of implements are a kind of double mould-board ploughs, and are used for the last hoeing, that is for hilling. The shape and use of these implements will be seen by reference to the diagrams, which illustrate the cultivator rigged for use at different stages of the growth of the crop. In using the beet-cultivator the thought that a variation from the true course of an inch and a half would destroy five rows of beets, is apt to make a beginner a little nervous, but practice soon satisfies him that it is easy to take care of one row, and that if he steers one share right the rest will take care of themselves.

The Beet-Digger.

The beet-digger is a strong and powerful machine, also drawn by two horses. It consists of two long knives, or coulters, fixed in a heavy framework, and so arranged that

they may be set to run to a greater or less depth, as may be desired. These knives run under and lift two rows of beets at each passage. As the machine passes along only a slight rippling or undulating motion is observed in the rows of beet-tops, but the roots are found to be loosened and cleared of dirt more perfectly than could be done by hand, and, as no roots are broken or left in the ground, a considerable increase in the crop is obtained. Like the beet-cultivator, the digger is steered by a lever at the hind end of the machine, and can be lifted to pass over obstructions, and for convenience of travel to and from the field.

Through the unexpected difficulties in obtaining the machinery, the planting was delayed three weeks beyond the proper season, and much time was necessarily consumed in experimenting with the implements, and in acquiring practical skill to use them to the best advantage. Under these circumstances it would be very unfair to give the results of this year's operations as a basis for calculating the cost of raising sugar-beets. I shall, therefore, simply state that the beet-crop on the four acres amounted to forty-eight tons, and that, from our experience with the machinery, I am led to the following conclusions: That these machines are constructed to work with mathematical exactness, and, if used at the right time and in the proper manner, on land suitably prepared, they will accomplish a very important saving of labor. It is obvious that, for cultivation, the smoother and more level the land the better; but this beet-machinery, like the mower and reaper, will do good work on rolling and uneven land. The beet-planter, or any part of it, may pass over stones or mounds without interfering with its operation, ample provision being made to enable each part to adapt itself to the inequalities of the land. But sods, long manure, corn-buts or litter of any kind, clog the drill-ploughs and prevent them from making furrows for the seed, which is consequently deposited on the surface. The necessity for care in driving need scarcely be alluded to.. Every farmer knows the advantage of having his rows parallel and equidistant, and when a machine cultivates five rows at one passage, cutting within an inch and a half of the plants on each side, the importance of precision in this respect is still more apparent. The cultiva-

tion must also be attended to at the proper time, since, if the weeds attain too vigorous a growth, the shares of the cultivator will become clogged and slip over the weeds without disturbing them. Finally, the crop must be kept free from weeds till it is harvested, otherwise the root-lifter, which on clean land is a model of simplicity and effectiveness, will become clogged and will not work at all. In short, it requires and abundantly rewards careful preparation of the land, punctual performance of the various operations of tillage, and perseverance in destroying weeds, which would otherwise mature and spread their seeds to the detriment of succeeding crops.

Wishing to test the adaptability of the beet-machinery to the cultivation of corn, I prepared five acres of land, planted it with corn and cultivated it in the following manner: The piece selected for the experiment was in grass, somewhat run out and in need of draining, and yielded, in 1871, about a ton to the acre of second-class hay. In the spring we carted and spread on manure, from the cellar, at the rate of thirty-five ox-cart loads to the acre, ploughed it in six inches deep the 28th of May, harrowed with the Nishwitz pulverizer, sowed on three hundred pounds of superphosphate and harrowed with Thomas's smoothing-harrow. May 31, we planted corn with the beet-planter, gauged to plant two or three kernels at intervals of twelve to eighteen inches in the rows. On four out of five acres we planted the rows three feet apart, but on the fifth acre we put three hundred pounds extra of superphosphate and planted in rows eighteen inches apart. The whole of the piece was afterwards harrowed with the smoothing-harrow, just as the corn was breaking ground, and again when the corn was eight inches high. When the corn was a foot high it was cultivated with the beet-cultivator, and was shortly afterwards thinned out to eighteen inches apart in the rows, but no other cultivation was given to the crop. Where the rows were three feet apart the corn was thinned to twelve inches apart in the rows, and the land was cultivated once with French's cultivator and again with Holbrook's horse-hoe, with hilling-ploughs. The remainder of the corn-land was manured and prepared in the same way, marked out into rows four feet apart and planted with the Woodward

planter, which distributed phosphate at the rate of two hundred pounds to the acre. Half of the piece was then harrowed with Thomas's harrow, when the corn was six inches high, and the whole twice cultivated with Holbrook's horse-hoe. The portion which was not harrowed had to be hoed by hand, as the weeds had attained such size in the rows that they could not be covered with the horse-hoe. The total yield of corn was nine hundred and six baskets of sound corn, equal to four hundred and eighty bushels of shelled corn, and sixty baskets of pig corn. The cost and yield, per acre, of the several methods of cultivation are computed as follows :—

No. of plot.	Cost of Labor.				Yield per Acre.		
	Preparing.	Cultiv'ting.	Harv'sting.	Total.	Sound corn.	Pig corn.	Stover.
1	$6 00	$3 15	$10 00	$19 15	80 bush.	600 lbs.	3 tons.
2	6 00	3 23	8 00	17 23	60 "	200 "	2 "
3	6 00	2 48	8 00	16 48	55 "	275 "	$2\frac{1}{2}$ "
4	6 00	5 48	8 00	19 48	52 "	400 "	$1\frac{3}{4}$ "

Estimating the rent at $6 per acre, charging $110 for eleven cords of manure and spreading, and $3 per cwt. for the superphosphate, and allowing half of the cost of the manure for the improved condition of the soil, the following would be about the way the accounts would stand with the different plots :—

Plot No. 1.—Planted by beet-machinery, in rows 18 inches apart.

Dr.	To labor,		$19 15
	interest on land,		6 00
	manure,		128 00
			$153 15
Cr.	By half manure,	$64 00	
	3 tons stover,	30 00	
			$94 00

Cost of 80 bushels, $59.15.
" 1 bushel, .73$\frac{13}{14}$.

Plot No. 2.—By beet-machinery, in rows 3 feet apart.

Dr.	To labor,		$17 23
	interest on land,		6 00
	manure,		119 00
			$142 00
Cr.	By half manure,	$59 50	
	2 tons stover,	20 00	
			$79 50

Cost of 60 bushels, $62.73.
" 1 bushel, 1.04½.

Plot No. 3.—Planted by Woodward planter, harrowed and twice cultivated.

Dr.	To labor,		$16 48
	interest on land,		6 00
	manure,		116 00
			$138 48
Cr.	By half manure,	$58 00	
	2½ tons stover,	25 00	
			$83 00

Cost of 55 bushels, $55.48.
" 1 bushel, 1.00$\frac{48}{55}$.

Plot No. 4.—Planted by Woodward planter, twice cultivated and once hand-hoed.

Dr.	To labor,		$19 48
	interest on land,		6 00
	manure,		116 00
			$141 78
Cr.	By half manure,	$58 00	
	1¾ tons of stover,	17 50	
			$75 50

Cost of 52 bushels, $65.98.
" 1 bushel, 1.26$\frac{23}{26}$.

In making this calculation, I have adopted the common rule of crediting the land with half the value of the manure; but I think that, both in feeding land and animals, we are apt to undervalue the residuum. Something should also be allowed for the benefits of tillage.

About half an acre under the woods, which was considered too heavily shaded for corn, was ploughed, harrowed with the Nishwitz harrow, manured with three hundred pounds of superphosphate, harrowed with Thomas's smoothing-harrow,

and then thrown into ridges, eighteen inches apart, with the beet-cultivator. Ruta-baga seed was then planted on the ridges with Holbrook's seed-sower, and the crop easily, cheaply and well cultivated with the beet-hoes. The situation was unfavorable, and the crop was attacked by aphides. Nevertheless, we harvested five tons of roots, at a cost of $24, of which sum $18.25 were paid for manure and harvesting.

We also used the beet-machinery to plant and cultivate an acre of fodder-corn, near the south barn. The machine was regulated to plant the kernels one to the foot, in rows eighteen inches apart. The yield was about all that could stand on the land, the expense of cultivation very little indeed, and the evenness, cleanness and luxuriance of the crop, at every stage of its growth, was a subject of admiration to all who visited the farm.

With the machinery ready for use in due season, with better preparation of the soil, and with the knowledge and practice gained by the past season's experience, it is expected that still better results will be obtained next year.

The rye was chiefly sown on land partially run out, and ploughed in September. Portions of it received a dressing of superphosphate, sent for trial, which gave no appreciable results. A small piece, which had been ploughed the previous spring and fallowed through the summer, yielded, both in grain and straw, nearly double the crop of apparently similar land ploughed immediately before sowing the rye. The yield of the piece was about ninety bushels of grain and five tons of straw.

The barley was sown on land where the sugar-beets grew last year, and is estimated at fifty bushels of grain and two and a half tons of straw. The grass-seed was sown with the barley, and made a luxuriant growth.

The oats were grown on various plots, and, in the early part of the season, promised well; but the unusual warmth and moisture produced a too succulent growth, and caused the plants to lodge wherever the soil was fertile. This materially diminished the yield, and affected the quality of both grain and straw. The total yield is estimated at three hundred bushels of oats and ten tons of straw.

The millet and fodder-oats were grown on land on which

corn was raised last year. Both produced good crops, fully two tons to the acre; but owing to the very unfavorable weather which prevailed at the time they were harvested, the cost of curing them was altogether out of proportion to their value.

The strawberries were carefully tended, mulched and kept free from weeds; they, nevertheless, suffered severely from the bleak severity of the winter. The raspberries and blackberries were only set out last year. Considering this, they made a good growth, but were also more or less injured by the intense cold and absence of snow. This year, they have become firmly established, and the canes have more than doubled in strength and luxuriance. I have had them cut back to four feet high, mulched and tied up to chestnut stakes, and I confidently expect a good yield of fruit next year.

The vegetable-garden was ploughed, manured with thirty-five cords of manure, harrowed, a portion of it graded, and the whole of it handed over to Professor Stockbridge, who, with the assistance of the students, raised luxuriant crops of garden vegetables of an almost endless variety.

The young apple, pear and peach orchards, the vineyard and the nursery, have also been kept cultivated. Some one thousand pounds of grapes were raised and sold by Mr. Ware, and the nursery furnished an abundance of trees for the improvement of the estate. The old apple-orchards were trimmed in the spring, with evidently beneficial results; but as they have been mown for a succession of years, and apples were very plentiful, a large proportion of the fruit had to be converted into cider.

It was feared that the droughts of the last two years, and the bleak severity of the winter, would render the hay-crop a very light one; but the moist weather of the spring and summer was very favorable for the growth of the grasses, and, with the aid of suitable machinery, we were enabled to harvest a more than average crop of hay in the finest possible condition. During a great part of haying, extremely fine days and very wet ones alternated with singular regularity. When the weather was fine, all hands were kept mowing till nine, then one pair of horses were put on to the tedders, and the grass was kept flying till noon. Directly after dinner,

the tedder was again started, to turn the hay last cut in the morning, while the early-mown hay was raked together, both with horse and hand rakes, and then we all worked at carting as long as we could see. In this way, with twelve men and five horses and a yoke of bulls, we frequently cut, made and secured, in tip-top order, eighteen tons of hay in one day. Reckoning eight of the men at $2.50 per day, the two double horse-teams at $5 each, and the single horse-team and yoke of bulls at $3 each, this would cost only $2 per ton. Allowing for interest on cost and wear and tear of machinery, and extra work done in wet weather, I estimate the average cost of securing the hay-crop at $4 per ton. When the weather was wet or lowering, we hauled loam to the yard, cleaned out the henneries, manufactured compost, trimmed the hay-mows, thinned and transplanted beets and turnips, ground scythes, oiled and cleaned wagons and machinery and got ready for another fine day. After the 1st of August, the alternations of rain and sunshine occurred several times each day, so that the securing of the rowen, like the millet and oats mentioned above, was not pecuniarily very profitable. The hay-crop altogether amounted to two hundred and eight tons, weighed when put into the barn.

There was an unexpended appropriation of $100 to purchase drain-tile, which I have applied where it was most urgently needed. Half-way between the boarding-house and the highway, there was a marshy swale, with a shallow ditch running through it, passing under the road, and discharging into the brook about twenty rods above the causeway. The land on each side this slough is much in need of cultivation, and, as a preliminary, I have substituted a covered drain of three-inch tile, one hundred rods long and three feet deep, for the open ditch.

Three hundred loads of compost have been taken from the yards and spread on the mowing-lands, and sand and loam have been drawn to the yards to furnish materials for next year's top-dressing. The manure made by cattle during the summer has been drawn out of the cellar and spread on the land intended for tillage next year, and the bottom of the cellar has been covered six to eight inches in depth with loam. The vaults have been cleaned from time to time, their contents

composted, and a supply of dry earth provided for daily use in arresting the gases, useful to plant, but offensive and injurious to animal, life.

During the months of January, February and March, the men and teams were pretty constantly occupied in falling, trimming and getting to the mill chestnut and pine timber for making trellis-posts for the vineyard, and posts and boards for fencing. Considerable team-work has also been done in levelling and filling up old gravel-pits and gulleys; in grading round the new shed; in laying water-pipes; in hauling baggage, coal, chemicals, cannon, sand, bricks, mortar and loam; in making and repairing roads, of which there are four miles seventeen rods; in aiding the students in setting out trees, laying out walks, and in generally improving and beautifying the estate.

Stock.

While striving to increase the productiveness, and permanently improve the condition of the farm, I have been especially mindful of the comfort and welfare of the live-stock. In this I have been influenced by two considerations: first, my natural love for animals, and my interest in all matters bearing on their management, development and improvement; and secondly, by the conviction that in no other way can the agricultural department be made so attractive to students, so beneficial to the community and so pecuniarily profitable to the College, as by breeding and keeping for sale thoroughbred animals of pure pedigree and high individual excellence. It is, therefore, a matter of rejoicing to me that in this respect we have been favored with uninterrupted prosperity. All the grade cattle have been sold, and all thoroughbreds which appeared to fall short of a high standard of practical utility have been sold to the butcher, and their place supplied with animals whose pedigree and performances are alike excellent.

The reputation of the College herd has been extended by the award of numerous first and sweepstakes premiums at three county shows, and also at the New England Society's Exhibition at Lowell, where we took, with eight animals, one sweepstake, two first and one second premium.

The only loss by death was the Devon cow, Gem 3d. Her disease, so far as symptoms were concerned, was a most ob-

scure one; but a post-mortem examination by Professor Clark revealed the fact that her trachea, lungs, liver, pleura and whole thoracic cavity were affected by a morbid growth, apparently of a schirrous nature. The viscera were removed by Professor Clark, for microscopic examination, and, after taking off her hide, we dissected her carcass, and placed it in boxes, which we sank in a deep creek, in order that the water might thoroughly macerate the flesh, and facilitate its perfect removal from the bones. When this is accomplished, the skeleton is to be prepared and set up for the anatomical museum of the College. In this connection, I may mention that by many cow-doctors the symptoms were referred to hornail, and it was only with the greatest difficulty that I prevented the most zealous from boring the suffering creature's horns and stuffing them with cayenne pepper, spirits of turpentine and other soothing preparations.

The increase by births has sufficed to supply the place of the grades and such thoroughbreds as it was thought best to discard, and also to give a slight foretaste of the profitableness of this branch of farming. During the past year, I have sold three young calves and four yearlings, five of them bulls, bred on the farm, for $685. These are very far from the prices which breeders of established reputation obtain for their stock, but certainly four times the price which common, or grade, animals would have brought, I am now preparing for publication a descriptive catalogue of the stock. This will save much time and labor of answering questions by letter, and with it the College will be in a favorable position for obtaining and pleasing customers, for extending its fame as an agricultural institution, and for making the farm pay. The collection of thoroughbred stock is now very excellent, comprising animals of seven different breeds of neat cattle. The opportunities for studying the properties, and comparing the merits, of the different breeds, are invaluable in an educational point of view; and among the visitors from various sections, the department is pretty sure to find customers for whatever it has to sell.

Some interesting experiments have been undertaken, and many practical thoughts have been suggested; but hitherto the attention of the farm committee has been directed chiefly

to the task of obtaining first-class specimens of the various breeds, and of bringing them all to a uniform standard of health, constitutional development and vigor. These objects being measurably accomplished, the way is prepared for more precise and reliable experiments relative to the products of the different breeds in proportion to the expense of keeping them, and also to the expediency and economy of different methods of breeding, teeding and managing stock.

The swine have also been prosperous and productive. The Improved Chester Whites have, as heretofore, been our main dependence. They will fat as early, and make as good pork, as any other breed, or, if kept to maturity, will attain a very large size. As examples of this double faculty, I may mention that Marmion, now two years and eight months old, weighs nine hundred pounds, and I have lately sold to Dr. Wakefield, for the state almshouse at Monson, a young boar, a son of Marmion, which, at twelve weeks old, weighed one hundred and twenty-eight pounds. The Improved Chesters also possess good forms, mild and contented dispositions, hearty appetites, vigorous digestions, robust constitutions, extraordinary prolificacy, and the disposition and ability to bring up the largest litters handsomely. It has, however, been thought proper, for experimental and educational purposes, to keep several breeds of swine, and I have purchased from different breeders a trio of Berkshires, of undoubted purity and evident quality; and Winthrop Chenery, Esq., of Belmont, has presented to the College a fine pair of Yorkshires.

The poultry department has been a source of much interest to students and visitors. The College has now valuable samples of the hardy, self-helpful Games, the nearest thoroughbred representative of the old barn-yard fowl, or, to go still further back, of the wild-fowl of the Indian jungle,—a good layer, a good but not inveterate sitter, and absolutely unequalled either as a mother or a table-fowl; the crested and bearded Houdans, and the golden-spangled Polands, whose instinct of reproduction is so strong that they cannot stop laying long enough to sit; and the large, amiable, white and partridge Cochins, which, with true Celestial persistency, will lay from December to March, because their ancestors did, but

in summer seem bent on doing, not only their own sitting, but also that of their more mercurial sisters. All the varieties have multiplied satisfactorily, and it is proposed to submit the merits of fowls from the College yards to public competition at the coming exhibitions.

The pigeon-house is stocked with the best procurable specimens of eight of the most prominent varieties. The beautiful Fantails, with snowy plumage, swanlike necks and fan-shaped tails, containing thrice the number of feathers which other pigeons possess; the pompous Pouters, of different colors, who strut about with their heads thrown back, and their crops puffed out to the shape and dimensions of a small football; the Carriers, with their wild, restless eyes, powerful wings and dashing carriage, with beak one-inch and three-quarters long, and wattles properly enough likened to an English walnut; and the Tumblers, who cannot fly from one roof to another without turning a somersault, whose beak must not exceed five-eighths of an inch, and whose wattle must look like a thread drawn across the beak; also the pretty Nuns, with black heads, tails and flights, and white bodies and hoods; while their ecclesiastical brethren, the Jacobins, with their white heads and tails, affect, by way of contrast, colored robes and cowls. These are some of the examples to be seen in the College lofts of the results of selective breeding, in perpetuating and intensifying accidental variations of structure and plumage. In pigeon-fancying, the breeder's skill has been tasked to the utmost to produce modifications of form and color which shall contrast as strongly as possible with each other, and in different particulars be as far as possible removed from the "Columba livia," or Blue Rock Dove, the original type and progenitor of all the varieties of fancy pigeons. So long as a systematic breeding is followed, these differences and peculiarities are not only maintained, but increased; while as soon as the different kinds begin to miscegenate, confusion ensues, the peculiarities of form and feather are obliterated, and, in a few generations, the progeny appear, and, indeed, are no more than common pigeons.

Pigeons are monogamous, and, when once properly mated, will produce pure-bred young, even when kept in communities of numerous varieties. The student of natural history is

thus enabled to observe the perfect similarity in their habits of mating, calling and driving to nest, building, laying, sitting, feeding young and other points common to the species; and at the same time to study the singular variations in form, feather and coloring which have been produced by earnest and long-continued attention to the practice of breeding for points. As they breed fast, and mature quickly, the effect of thorough-breeding, and also of crossing the breeds, can be more quickly and effectively illustrated than with the larger and longer-lived animals. I make this explanation because I perceive the keeping of pigeons is very generally considered puerile and unworthy the attention of serious people, while I submit that the faculty of observing and appreciating those slight differences which materially affect the value of stock can in no other way be so cheaply, pleasantly and thoroughly cultivated.

The teams consist of five horses, all superior animals, and two pairs of bulls. The practice of using the large bulls in place of oxen has worked very satisfactorily, and is every way advantageous; and the young bulls are all trained to the yoke, and exercised in proportion to their age and strength.

The two-year-old filly has grown finely, and is a very promising animal.

A first-rate stallion, with plenty of size, bone, symmetry, gait, courage and endurance, and with accumulated hereditary power to transmit these qualities to his descendants, would be a benefit to the community, an ornament to the farm and a desirable step toward making the College a complete mirror and repository of the highest progress and most valuable productions in every branch of agriculture.

The College also needs, as part of its educational apparatus, a small flock of sheep. These should, of course, be of the best quality and the finest blood. Such animals are so costly, and the danger from dogs is so great, that I have not thought it safe to purchase them without your express instructions.

Farm-Buildings.

At noon, on the 10th of August, the barn at the north end of the farm, known as "the Crouch barn," and used for storing mowing and reaping machines, sleds, cart-bodies and other

large implements, was burnt down. By the strenuous exertions of professors and students, farm-hands and neighbors, aided by a favorable wind, the shed adjoining the barn, and also the barn occupied by Mr. Gallond, were saved. It was also remarkable that at no time would the loss have been so slightly felt, as two of the mowing-machines, a horse-rake and a tedder were in use in the field. Still, the property destroyed considerably exceeded the sum paid for insurance. A horse-power and threshing-machine, belonging to Professor Stockbridge, which the College had been accustomed to borrow, were also burnt, and the necessity for a new thresher and horse-power is severely felt. The property was insured in the People's Fire Insurance Company for $1,500, which was promptly paid.

The new sheds are found to answer perfectly the purposes for which they were designed, and, in connection with the barn, are all that are at present needed at the south end of the farm.

The old buildings at the north end of the farm, where the teams are kept, are in a somewhat dilapidated condition. I have patched them up from time to time, but have not felt justified in spending any considerable amount of money in repairing them. The loss of the Crouch barn renders some provision for housing the tools necessary, while the sum paid by the insurance company would be amply sufficient to repair the old buildings, and to erect such new ones as are required.

Students.

My intercourse with the students has been extremely cordial and agreeable. As these gentlemen can only work in the intervals of their studies, they cannot be profitably employed to drive the teams, and four men are therefore hired as teamsters. The whole of the work about the barns; the milking, cutting roots and fodder; the cooking, cleaning, feeding, sweeping and carding; the training of bulls and colts; the ringing of bulls and the attendance on animals during parturition and in sickness,—are all done by students. Of their fidelity and efficiency, the appearance of the barns, and the docility, thriftiness and general prosperity of the stock, are the best evidences. Among my valued assistants, I am

proud to number members of each of the four classes; and as the successive classes enter the College, it is encouraging to observe that the proportion of students who are farmers' sons, trained to farm-work, increases year by year.

The system of cultivating the field-crops, adopted and described, has almost entirely relieved the students from the labor of hand-planting and hoeing. During the spring term, much of the class-work, outside of the planting and cultivation of the vegetable-garden, was therefore employed in making permanent improvements. In the fall term, the students, under the direction of Professor Stockbridge, were profitably employed in digging potatoes, cutting, stacking and husking corn, picking apples and topping and harvesting beets and turnips.

Farm Economy.

In every department, I have endeavored to practise the closest economy consistent with a sincere regard for the prosperity of the College, and especially of the farm. In my former reports, I have referred to the distractions and encumbrances which accompany the duties of my office. These will continue to exist so long as the College enjoys its present prosperity, and struggles for a place among the pioneers of improved agriculture. It has, therefore, been my aim to establish a branch of farming for which the position of the College offers advantages more than sufficient to counterbalance the inconveniences alluded to,—I mean, of course, the breeding and selling of first-rate stock. To this end, I have striven diligently to procure a collection of superior animals, and to establish for them a reputation, which will enable the College to sell their progeny at remunerative prices. In my anxiety to accomplish this object, I have doubtless increased the expenses of the year, and sacrificed something of the income which might have been obtained if my efforts had been more persistently given to securing the greatest immediate pecuniary results. I submit, however, that any advantages so gained would have been only temporary and comparative. For the reasons referred to, the College cannot compete in the production of ordinary crops with farmers who devote their whole attention to their business, and are free from the distractions incident to the position of the College as a public

educational and experimental institution. In the manner indicated, the farm may, with proper diligence and judgment, be made, not only self-supporting, but also by degrees a source of considerable income to the College, and at the same time a means of education to the students, an object of interest to visitors, a repository and exchange of agricultural information, a valuable theatre for reliable and well-considered experiments, and a permanent benefit to the farming community.

The following is a list of the thoroughbred stock belonging to the College:—

SHORTHORNS.

Males.—Mountain Lad (8,673), Belted Will, Yarico's Lad. *Females.*—Autumn Rose, Autumn Lily, Lilian, Yarico 57th, Belladonna, Peachbud 8th, Wistaria, Aurora 4th, Barre Belle, Emma 3d, Emma 4th and Bella Wilfer.

The pedigrees of all these animals are either recorded, or accepted for record, in the Shorthorn Herd-book.

AYRSHIRES.

Males.—Colfax (127), Lord Ronald, Ronald Roy. *Females.*—Beauty (8), Tulip 4th (799), Juna (507), Lulie (1,500), Rosa (1,780), Beauty (870), Alice Brand, Beauty 10th.

These animals have all perfect pedigrees, and are either recorded, or will be recorded, in due season.

JERSEYS.

Males.—Enterprise, Grand Duke. *Females.*—Lucy, Rosy, Hattie, Lady Essex, Success.

The pedigrees of these animals are accepted for record, and will appear in the forthcoming volume of the Jersey Herd-book.

DEVONS.

Males.—General Lyon (232), King Arthur. *Females.*—Pixie (1,199), Enid (934½).

BRITTANIES.

Males.—Upton, Merlin. *Female.*—Pauline.

SWISS.

Male.—Belmont.

DUTCH OR HOLSTEIN.

Male.—4th Highland Chief.

SWINE.

12 Chester Whites, 3 Berkshires, 2 Yorkshires.

Poultry.

Games (6 varieties), 70; Cochins (Partridge and White), 15; Houdans, 14; Gold-spangled Polands, 5; Sebright Bantams, 3; Bronze Turkeys, 12; Rouen Ducks, 4; Pigeons, 31, viz.: Carriers, Pouters, Tumblers (Baldpates, Beards, Splashed and Almond), Fantails, Jacobins, German Nuns, Archangels.

REPORT

OF THE

EXAMINING COMMITTEE

OF THE

BOARD OF AGRICULTURE,

OVERSEERS OF THE COLLEGE.

REPORT.

Your Committee, appointed to visit the Agricultural College, have the honor to report as follows :—

The Chairman attended the examinations in April and November, the other members of the Committee at Commencement, and were much pleased with the general appearance of the College, the efficiency and earnestness of its officers and professors, and with the apparent zeal and interest of most of the young men who are availing themselves of the great advantages there presented them.

It is truly wonderful that in so short a time this admirable institution should have assumed such proportions. Only incorporated in 1863, receiving its first class late in 1867, it now stands in the front rank of agricultural colleges in this country, an object of reasonable pride to the Commonwealth.

The buildings are substantial and well-arranged, the dormitories most comfortable, the lecture-rooms and drill-rooms large and airy. The new barn, well filled with several varieties of pure-bred stock, and with the products of the farm, presents a tempting place of resort to the students at all times.

The classes in April were examined in botany, moral philosophy, agricultural chemistry, mathematics, English literature and practical farming.

At Commencement (*inter alia*), in the relation of science to practice in agriculture, renovation of exhausted soils, rotation of crops, manures, stock-husbandry, and in agriculture as a business pursuit.

In November, in road and railroad construction, zoölogy, use of manures, chemistry and military drill ;—all of which were creditable alike to professors and students, the relations between whom seem to be of the most agreeable nature.

The military exercises, under the careful instruction of Lieut. Merrill, U. S. A., were excellent, and are apparently viewed by the students more as a recreation than a task. The College is fortunate in having such an officer detailed by government for this department. This officer also inspects all the dormitories every week, making the most careful and minute examination as to the *orderly* and *cleanly* habits of the young men.

The farm, under the careful and intelligent management of Mr. Dillon, is constantly improving, and shows for the last year quite satisfactory results, though it has, of course, to contend with many and quite necessary obstacles to the most profitable returns. The necessity of carrying out experiments in manures, in rotations, in various machinery and modes of cultivation is naturally at times quite unremunerative. The labor of the students is, though well paid, not so economical as the steady employment of hands skilled in the performance of the various farm-work. Some of the experiments with new machinery have, however, proved very satisfactory, especially the Dibble-machine imported from Germany, which sows eight rows at a passage, and the *Rüben-Hack* machine or root-cultivator, also a German invention, which cultivates five rows at a passage. The experiment of planting and cultivating corn with these machines without hand-labor was very successful.

Hay was in great measure cut and housed the same day, and is sweet and well colored.

When it is considered that labor must be laid out in beautifying the farm, and in fitting it for its various purposes, of a stock-raising and seed-growing farm, a nursery, a botanical garden, conservatory, arboretum; apple, pear and peach orchard; vineyard, market-garden, experimental station, veterinary hospital and a parade-ground; and all this to be performed as economically as possible, and at the same time to make the works subserve the two important offices of furnishing employment and practical instruction to the students,* it is quite astonishing that the crops on the farm are so good and the stock so well cared for.

* Answers by J. C. Dillon to interrogatories proposed by the Commissioner of Agriculture.

The conservatory is a beautiful and instructive feature of the College. Like all other blessings, however, it generally suggests the great advantage of a large increase of glass, this being now a department which might be made very remunerative to the College and at the same time of great benefit to the students.

The laboratory, the mathematical and philosophical apparatus are excellent, and under the competent instruction of the learned professors of chemistry and mathematics, render attractive, as well as comprehensible, the various departments which they serve to illustrate.

This being founded as an *Agricultural* College, where young men may acquire the best knowledge of farming and its kindred pursuits, in fact, of all which modern science and experiment is capable of affording them, your Committee endeavored, by the most careful attention, to learn whether the College is pursuing such a course as was intended by the Federal Government, as well as by the Commonwealth, and they can cheerfully and conscientiously bear witness to the truth of the affirmative.

The education which is here received is no more extended than ought to be borne away from such a college, and ought to fit a young man to carry on profitably and pleasurably to himself, as well as with advantage to his neighbors, a farm for any purpose; to become an engineer, mechanic, superintendent, agricultural editor, and to pursue the various paths where a man may become useful to the agricultural community. He learns more or less of that manliness which is inspired by daily exercise as a soldier, as well as to defend his country in time of need; an admirable feature of the institution and wisely required by the government.

The statistics of the occupations chosen by the graduates show that a large number have adopted agricultural pursuits as their permanent occupation. It cannot of course be expected that the whole or any certain proportion of the young men should adhere to a purpose which may have been seriously entertained by them on entering this College, of becoming farmers. As character is developed by education, the tastes and feelings are greatly changed, and the paths pursued by them must necessarily diverge. If, however, each class turns

out a reasonable number of intelligent, scientific agriculturists, then may the College well be considered as fulfilling the intention of its foundation.

To the energy, zeal and fidelity of the President, with his able corps of professors, this pioneer work (as it is in America) owes its wonderful advancement. For though agricultural schools and colleges abound in England and Germany, yet they can neither of them, for various reasons, serve as exact models for what is required in Massachusetts.

Its future in great measure depends on the support which it meets from the class of people for whose benefit it was directly intended.

It is now full, but is it never to expand into larger proportions?

Let the Massachusetts farmers feel that interest, that pride, and give that support to this College which they ought, and it will be an honor to the Commonwealth and a blessing to her children.

LEVERETT SALTONSTALL,
S. B. PHINNEY,
A. J. BUCKLIN,
Committee.

CATALOGUE

OF

TRUSTEES, OVERSEERS, FACULTY AND STUDENTS.

1872.

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JOHN C. DILLON, Farm Superintendent.

GRADUATES OF 1871.

Allen, Gideon Hammond,	Farmer,	North Conway, N.H.
Bassett, Andrew Lewis,	Civil Engineer,	Amherst.
Birnie, William Perkins,	Farmer,	Springfield.
Bowker, William Henry,	Editor,	Boston.
Caswell, Lilley Brewer,	Civil Engineer,	Fitchburg.
Cowles, Homer Lucian,	Farmer,	Hadley.
Ellsworth, Emory Alexander,	Civil Engineer,	Florence.
Fisher, Jabez Franklin,	Merchant,	Minneapolis, Minn.
Fuller, James Elwyn,	Civil Engineer,	Toledo, Ohio.
Hawley, Frank Warren,	Farmer,	Simsbury, Conn.
Herrick, Frederick St. Clair,	Farmer,	North Andover.
Leonard, George,	Farmer,	New Bedford.
Lyman, Robert Worthington,	Civil Engineer,	Baltimore, Md.
Morse, James Henry,	Civil Engineer,	Salem.
Nichols, Lewis Abel,	Civil Engineer,	Boston.
Norcross, Arthur Dickinson,	Farmer,	Monson.
Page, Joel Bardwell,	Farmer,	Conway.
Richmond, Samuel Howard,	Draughtsman,	Fall River.
Russell, William Delano,	Chemist,	Turner's Falls.
Smead, Edwin,	Gardener,	Baltimore, Md.
Sparrow, Lewis Addison,	Chemist,	Boston.
Strickland, George Porter,	Civil Engineer,	Red Wing, Minn.
Thompson, Edgar Eliab,	Druggist,	North Bridgewater.
Tucker, George Homer,	Civil Engineer,	Corry, Penn.
Ware, Willard Carroll,	Gardener,	Amherst.
Wheeler, William,	Civil Engineer,	Hardwick.
Whitney, Frank Le Prelet,	Gardener,	Boston.
Total,		27

GRADUATES OF 1872.

Bell, Burleigh Cook,	Winchester.
Brett, William Franklin,	North Bridgewater.
Clark, John Wesley,	Geneva, N. Y.
Cowles, Frank Colton,	Amherst.
Cutter, John Clarence,	Warren.
Dyer, Edward Norris,	Shrewsbury.
Easterbrook, Isaac Henry,	Boston.
Fiske, Edward Ransom,	Philadelphia, Pa.
Flagg, Charles Otis,	Montgomery, Ala.
Grover, Richard Baxter,	Monson.
Holmes, Lemuel Le Baron,	Mattapoisett.
Kimball, Francis Elliot,	Dudley.
Livermore, Russell Woolcott,	Lebanon, Conn.
Mackie, George,	New Bedford.
Maynard, Samuel Taylor,	Brighton.
Morey, Herbert Ellis,	Malden.
Peabody, William Russell,	Boston,
Salisbury, Frank Batelle,	Sherborn.
Shaw, Elliot Dwight,	Chicopee.
Snow, George Henry,	Leominster.
Somers, Frederick Maxwell,	Springfield, O.
Thompson, Samuel Clarence,	Southborough.
Wells, Henry,	Stockbridge.
Whitney, William Channing,	Boston.
Total,	24.

SENIOR CLASS.

Clark, William Jared,	Cincinnati, Ohio.
Eldred, Frederick Cornelius,	Sandwich.
Frisbie, George Benedict,	New York City.
Furness, George Abbott,	Tarrytown, N. Y.
Leland, Walter Sherman,	Sherborn.
Lyman, Asahel Hubert,	Westhampton.
Mills, George Westgate,	Medford.
Minor, George Bacon,	Hartford, Conn.
Penhallow, Jacob Pearce,	Portsmouth, N, H
Renshaw, James Budden,	Richmond.
Simpson, Henry Bell,	Hudson, N. Y.
Tucker, Charles Edward,	Boston.
Warner, Seth Smith,	Florence.
Webb, James Henry,	New Haven, Conn.
Wellington, Charles,	Amherst.
Wood, Frank Warren,	Grafton.
Total,	16.

JUNIOR CLASS.

Adams, Frank Edgar,	Hadley.
Alexander, Edward Percival,	Greenville, Ill.
Babbitt, George Henry,	Columbus, Ohio.
Benedict, John Mitchell,	Bethel, Conn.
Blanchard, William Henry,	Putney, Vt.
Chandler, Edward Phelps,	Westborough.
*Clark, William Avery,	Springfield.
Curtis, Wolfred Fletcher,	Westminster.
Dickinson, Asa Williams,	Amherst.
Gillett, Edward,	Southwick.
Hitchcock, Daniel Green,	Warren.
Hobbs, John Alden,	Northampton, N. H.
Johns, Arthur Clifford,	St. Charles, Mo.
Libby, Edward Howard,	Ashland.
Lyman, Henry,	Middlefield, Conn.
Montague, Arthur Huntington,	Granby.
Moody, George Frederick,	Springfield.
Ould, Remus,	Baltimore, Md.
Smith, Frank Stockbridge,	Springfield.
Smith, James Metcalf,	Westfield.
Strain, William,	Southwick.
Woodman, Edward Eastman,	Danvers.
Zeller, Harrie McKeen,	Hagerstown, Md.
Zeller, William Melville,	Hagerstown, Md.
Total,	24.

* Deceased.

SOPHOMORE CLASS.

Andreae, George Christ,	New York City.
*Ashton, John,	Newton Centre.
Barrett, Joseph Francis,	Barre.
Barri, John Atherton,	Cambridgeport.
Bragg, Everett Burt,	Amherst.
Brooks, William Penn,	South Scituate.
Bunker, Madison,	Nantucket.
Callender, Thomas Russell,	Northfield.
Campbell, Frederick George,	W. Westminster, Vt.
Carruth, Herbert Schaw,	Boston.
Chase, Edmund Taylor,	Deerfield, N. H.
Clark, Xenos Young,	Amherst.
Clay, Jabez William,	Westminster, Vt.
Deland, Thomas James,	Boston.
Dodge, George Rufus,	Hamilton.
Ellis, Granville Alden,	New Bedford.
Frothingham, Thomas Goddard,	Boston.
Hague, Henry,	Lonsdale, R. I.
Harwood, Peter Mirick,	Barre.
Hatch, George Stanley,	Medford.
Holmes, Harry Hawley,	Greenwich, N. Y.
Jackson, Henry Stranahan,	Orange, N. J.
Kinsman, Willard Francis,	Ipswich.
Knapp, Walter Haydn,	Auburndale.
Lee, Lauren Kellogg,	Shrewsbury.
Merrill, James Cushing,	St. Albans, Vt.
Merrill, Nathaniel Pinkham,	Wilbraham.
Miles, George Melville,	Westminster.
Otis, Harry Preston,	Northampton.
Parker, Francis Greenwood,	Brooklyn, N. Y.
Peabody, Cecil Hobart,	Amherst.
Platt, William Davenport,	Baltimore, Md.
Reed, Fremont Sumner,	South Weymouth.
Rice, Frank Henry,	Barre.
Rotch, Caleb Lamb,	Chilmark.
Snow, Laban,	Harwich.
Southwick, Andre Arnold,	Mendon.
Stearns, Richard Sprague,	Salem.
Thomas, John Louis,	Boston.
Vaill, William Henry,	Enfield.
Weeks, Herman Franklin,	Babylon, N. Y.
Winchester, John Frost,	Peabody.
Total,	42.

* Deceased.

FRESHMAN CLASS.

Bagley, David Appleton,	Winchendon.
Chickering, Darius Otis,	Enfield.
De Pew, Richard Mather,	Amherst.
Deuel, Charles Frederick,	Amherst.
Ellis, Edward Story,	Watertown.
Guild, George William May,	New York City.
Graves, Louis Bertrand,	South Ashfield.
Hawley, Joseph Mather,	Salem, N. Y.
Jefts, Melvin Willard,	Ashby.
Judd, Charles Adelbert,	South Hadley Falls.
Kendall, Hiram,	Watertown.
Ladd, Thomas Henry,	Watertown.
Lawton, Charles Follen,	New Bedford.
Leach, Frank Hervey,	Amherst.
Mann, George Hewins,	Sharon.
Martin, William Edson,	Hadley.
McConnel, Charles Washington,	Lonsdale, R. I.
McLeod, William Alexander,	Lonsdale, R. I.
Naito, Saitaro,	Chiyoshiu, Japan.
Parker, Edward Herbert,	Reading.
Parker, George Amos,	Gardner.
Parker, George Lowell,	Dorchester.
Perkins, William Henry,	Watertown.
Porter, William Henry,	Hatfield.
Preston, Edward George,	Elbridge, N. Y.
Robinson, John Albert,	Brookline.
Rogers, Mulford Thacher,	Watertown.
Root, Joseph Edward,	Barre.
Sanger, Frank Hyde,	Watertown.
Sears, John Milton,	Ashfield.
Slade, Denison Rogers,	Chestnut Hill.
Smith, Thomas Edwin,	Springfield.
Spooner, Frank Adams,	Barre.
Taft, Cyrus Appleton,	Whitinsville.
Urner, George Peter,	Elizabeth, N. J.
Wetmore, Howard Graham,	New York City.
Williams, John Elgin,	South Amherst.
Total,	37.

SELECT CLASS.

Barber, Strong Hayden,	Windsor, Conn.
Bardwell, Daniel Packer,	Shelburne.
Barstow, William Hale,	Haverhill, N. H.
Carter, Samuel Marshall,	Berlin.
Carter, Walter Edward,	Boston.
Clark, Charles Tilden,	Sherborn.
Clark, Lysander Lyman,	Easthampton.
Cook, Rufus Lyman,	Hadley.
Dix, James Quincy,	Boston.
Duncan, James Adams,	Keene, N. H.
Eaton, Harry Ahpeetcha,	Norfolk, Virginia.
Ely, William Isaac,	Freehold, N. J.
Gibbs, Charles Finney,	Thetford, Vt.
Greene, Frank Bradford,	Hadley.
Hadwen, William Ernest,	Worcester.
Hobbs, Joseph Oliver,	Boston.
Judkins, Arthur Munroe,	Winchester.
Lyman, Arthur Webster,	Southampton.
Merriam, Joel Hervey,	Westminster.
Mildeberger, Victor,	New York City.
Player, Harry Heyward,	Nashville, Tenn.
Sanger, Herbert Claflin,	Sherborn.
Swift, Frank Munroe,	Yarmouth.
Taylor, Ralph Ives,	Great Barrington.
Towne, Frank Augustus,	Keene, N. H.
Wakefield, A. B. Albert Tolman,	Marietta, Ohio.
Wright, Augustus Hunt,	Boston.
Zeller, Bruce Scott,	Hagerstown, Md.
Total,	28.

SUMMARY.

Graduates of 1872,	24
Seniors,	16
Juniors,	24
Sophomores,	42
Freshmen,	37
Select,	28
Total,	171

COURSE OF STUDY AND TRAINING.

Freshman Year.

First Term.—Chemical Physics, 5 hours each week; Human Anatomy Physiology and Hygiene, 3 hours; Algebra, 5 hours; English, 2 hours; Agriculture, 3 hours; Declamation, 1 hour; Free-hand Drawing, 2 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

Second Term.—Inorganic Chemistry, 4 hours; Human Anatomy, Physiology and Hygiene, 3 hours; Geometry, 5 hours; Agriculture, 4 hours; English, 2 hours; Elocution, 1 hour; Free-hand Drawing, 2 hours; Military Drill, 4 hours.

Third Term.—Organic and Practical Chemistry, 8 hours; Geometry and Conic Sections, 4 hours; French, 5 hours; Elocution, 1 hour; Agriculture, 2 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

Sophomore Year.

First Term.—Agricultural and Analytical Chemistry, 8 hours each week; Analytical Geometry, 4 hours; French, 5 hours; Agriculture, 2 hours; Declamation, 1 hour; Military Drill, 4 hours; Manual Labor, 6 hours.

Second Term.—Quantitative Chemical Analysis, 7 hours; Trigonometry, 5 hours; French, 4 hours; Agriculture, 4 hours; Declamation, 1 hour; Military Drill, 4 hours.

Third Term.—Zoölogy, 5 hours; Surveying, 5 hours; Agriculture, 2 hours; English, 3 hours; Declamation, 1 hour; Drawing, 4 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

Junior Year.

First Term.—German, 5 hours each week; Mechanics, 5 hours; Entomology and Zoölogy, 3 hours; Market-gardening, 2 hours; Levelling and Drawing, 5 hours; Military Drill, 3 hours; Manual Labor, 6 hours.

Second Term.—German, 4 hours; Physics, 5 hours; Botany, 4 hours; Microscopy, 2 hours; Drawing, 4 hours; Agricultural Debate, 1 hour; Military Drill, 4 hours.

Third Term.—German, 4 hours; Astronomy, 4 hours; Botany, 4 hours; Topographical Surveying, 4 hours; Stock and Dairy Farming, 2 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

Senior Year.

First Term.—English Literature, 4 hours each week; Botany, 2 hours;

Veterinary Science, 5 hours; Book-keeping, 2 hours; Civil Engineering, 3 hours; Drawing, 3 hours; Original Declamation, 1 hour; Military Drill, 3 hours; Manual Labor, 6 hours.

Second Term.—English Literature, 4 hours; Mental Science, 4 hours; Arboriculture, 2 hours; Veterinary Science, 3 hours; Drawing, 3 hours; Military Drill, 4 hours.

Third Term.—Roads and Railroads, 5 hours each week; Geology, 3 hours; Landscape-gardening, 2 hours; Rural Law, 1 hour; Agriculture and Review, 2 hours; Military Drill, 4 hours; Veterinary Surgery, 2 hours.

CALENDAR FOR 1873.

The second term of the collegiate year begins January 2, and continues till April 2.

The third term begins April 17, and continues till July 16.

The first term begins August 28, and continues till the Wednesday before Thanksgiving.

There is an Examination of candidates for admission to the College, at the Botanic Museum, at 9, A.M., Tuesday, July 15, and also on Thursday, August 28.

The annual Public Examination and the Prize Declamations take place Monday, July 14.

The exercises of Class Day, and the Address before the Literary Societies, take place on Tuesday, July 15. The exercises of Graduation Day occur July 16.

ADMISSION.

Candidates for admission to the Freshman Class are examined, in writing, upon the following subjects: English Grammar, Geography, Arithmetic, and the History of the United States.

Candidates for higher standing are examined as above, and also in the studies gone over by the class to which they may desire admission.

No one can be admitted to the College until he is fifteen years of age, and every student is required to furnish a certificate of good character from his late pastor or teacher, and to give security for the prompt payment of term bills. Tuition and room-rent must be paid in advance, at the beginning of each term, and bills for board, fuel, &c., at the end of every term.

The regular examinations for admission are held at the Botanic Museum at 9 o'clock, A.M., on Tuesday, July 15, and on Thursday, August 28; but candidates may be examined and admitted at any other time in the year.

Further information may be obtained from President W. S. Clark, Amherst, Mass.

EXPENSES.

Tuition, ...	$18 00 per term.
Room-rent, ...	5 00 "
Incidental expenses, ...	1 00 "
Board, ...	3 50 per week.
Expenses for Chemical Laboratory to Students of Practical Chemistry, ...	5 00
Public and private damages, including value of chemical apparatus destroyed or injured, ...	at cost.
Annual expenses, including books, ...	250 00 to 300 00

REMARKS.

The regular course of study occupies four years, and those who complete it receive the degree of Bachelor of Science.

The instruction in the languages is intended to qualify the graduates to write and speak English with correctness and effect, and to translate German and French with facility. The scientific course is as thorough and practical as possible, and every science is taught with constant reference to its application to agriculture and the wants of the farmer.

The instruction in agriculture and horticulture includes every branch of farming and gardening which is practised in Massachusetts, and is both theoretical and practical. Each topic is discussed thoroughly in the lecture-room, and again in the plant-house or the field, where every student is obliged to labor. The amount of required work, however, is limited to six hours per week, in order that it may not interfere with study. Students are allowed to do additional work, provided they maintain the necessary rank as scholars. All labor is paid at the rate of ten to twenty cents per hour, according to its value. There is no provision for indigent students beyond the opportunity to do such work as may offer about the public and farm buildings, or in the field, and it is hardly possible to earn more than from $50 to $100 per annum, besides performing other duties. So far as is consistent with circumstances, students will be permitted to select such varieties of labor as they may for special reasons desire to engage in.

Those who pursue a select course attend recitations and lectures with the regular classes; but persons properly qualified who desire special instruction in chemistry, civil engineering, veterinary science, agriculture or horticulture, may make private arrangements with the officers having charge of these departments.

An expenditure of from $10 to $50 is necessary to provide furniture, which may be purchased at reasonable rates, either new or second-hand.

On Sundays, students are expected to attend the chapel-service and Bible-class, which are conducted by the Professor of Moral Science. While the Bible is made the basis of all religious instruction, everything of a denominational character is, as far as practicable, avoided.

Students may, upon the written request of their parents or guardians, be excused from these exercises to attend services in one of the churches of the town.

REGULATIONS.

1. Students are specially forbidden to combine together for the purpose of absenting themselves from any required exercise or violating any known regulation of the College.

2. The roll shall be called five minutes after the ringing of the bell for each exercise of the College by the officer in charge, unless a monitor be employed, and students who do not answer to their names shall be marked absent; provided that any student coming in after his name has been called shall be marked tardy. Two tardinesses shall be reckoned as one absence.

3. Absence from a single exercise may be allowed or excused by the officer in charge of the same; but permission to be absent from several exercises must be obtained from the general excusing officer, or from the President. In such cases a certificate of excuse will be furnished by the excusing officer, which shall state the precise time for which the permission of absence is granted, and shall be a satisfactory reason for absence from all exercises occurring within the time specified.

All excuses must be promptly rendered, and officers will not be expected to receive them unless offered within one week from the occurrence of the absence, provided there has been an opportunity for presenting them.

4. Whenever the aggregate number of unexcused absences in all departments reaches five, the student so delinquent shall be informed of the fact. When the number of such absences reaches eight, the President shall notify the parent or guardian of the student of his delinquency; and when *ten* such delinquencies are justly recorded against any student, his connection with the College may be terminated.

5. Students are forbidden to absent themselves without excuse from the regular examinations, to give up any study without permission from the President, or to remove from one room to another without authority from the officer in charge of the dormitory buildings.

6. The record of deportment, scholarship and attendance will be carefully kept, and whenever the average rank of a student for any term falls below fifty, he will not be allowed to remain a member of the College, except by a special vote of the faculty.

7. Students are required to abstain from everything injurious to the

buildings and other property of the College, and in all respects to be gentlemen.

8. Students will not be excused from regular duty to engage in boating.

BOOKS, APPARATUS, AND SPECIMENS IN NATURAL HISTORY.

The library of the College contains about 1,000 volumes. Among them are several valuable sets of cyclopædias, magazines and newspapers, reports of agricultural societies and state boards of agriculture, and many standard works on agriculture and horticulture. There are many useful works of reference in chemistry, botany, surveying and drawing. The larger part of the books have been presented to the Institution by private individuals.

The faculty and students also have the privilege of drawing books from the excellent library of Amherst College, which contains nearly 30,000 volumes.

The State Cabinet of specimens illustrating the Geology and Natural History of Massachusetts has been removed from Boston to the College, and is of much value for purposes of instruction.

The Knowlton Herbarium contains more than 10,000 species of named botanical specimens, besides a large number of duplicates. The Botanic Museum is supplied with many interesting and useful specimens of seeds, woods and fruit-models. There is, also, a set of diagrams, illustrating structural and systematic botany, including about 3,000 figures.

About 1,000 species and varieties of plants are cultivated in the Durfee Plant-house, which affords much pleasure and information to students of both colleges.

The very extensive and, in many respects, unsurpassed collections in geology, mineralogy, natural history and ethnology, belonging to Amherst College, are accessible to members of the Agricultural College.

The chemical, engineering and military departments of the Agricultural College are well furnished.

The armory contains two brass pieces of artillery, fifty sabres and one hundred and fifty breech-loading rifles.

FARNSWORTH RHETORICAL MEDALS.

Since this Report went to press, Isaac D. Farnsworth, Esq., of Boston, has generously provided a fund for the purchase of gold and silver medals, to be annually awarded, under the direction of the College faculty, for excellence in Declamation.

FINANCIAL STATEMENT,

JANUARY 1, 1873.

REAL ESTATE,

College Farm and Quarry,	$37,500 00
South College,	36,000 00
North College,	36,000 00
College Hall,	30,000 00
South Boarding-house,	8,000 00
North Boarding-house,	8,000 00
Durfee Plant-house,	12,000 00
Botanic Museum,	5,000 00
South Barn,	14,500 00
Farm-house	4,000 00
Four Dwellings and Barns, purchased with the estate,	9,000 00
Total Real Estate,	$200,000 00

FARM STATEMENT.

Value of Live-stock,	$10,165 00
of Vehicles and Implements,	2,351 00
of Produce on hand,	6,314
	$18,830 00

Total credits of Farm, including property inventoried, Jan. 1, 1872, credit for labor performed in grading, &c., and receipts from sales of live-stock and produce,	$24,647 60
Total debits of Farm, including property inventoried Jan. 1, 1872, and all expenditures for live-stock, labor, implements, repairs, seeds, fertilizers, &c.,	$25,463 34

FUND FOR MAINTENANCE OF THE COLLEGE;

IN CHARGE OF THE STATE TREASURER.

The total amount received from the sale of 360,000 acres of land, given to Massachusetts for the endowment of one or more colleges for the promotion of education in agriculture and the mechanic arts, was	$236,307 40
Of this amount, in accordance with the Act of Congress, was expended for a farm, ...	29,778 40

The sum of $208,464.65 which was received for $\frac{9}{10}$ of the land-scrip was constituted, in 1863, a perpetual fund for the promotion of education in agriculture and the mechanic arts. In 1871, this fund was increased by the legislature to $350,000.

The investments of this fund, made by the State Treasurer, are as follows:—

United States bonds, 5–20's, interest 6 per cent., gold, .	$50,500 00
" " " 10–40's, " 5 " " . .	30,000 00
Massachusetts bonds, 5 per cent., gold, ...	24,000 00
" " 6 per cent., currency, ...	3,000 00
City of Salem bonds, 6 " "	55,000 00
City of Lynn bonds, 6 " "	25,000 00
Town of Milford b'nds, 6 " "	14,200 00
of Plymouth note, 6 " "	6,724 65
of Brighton note, $6\frac{1}{2}$ per cent., ...	10,000 00
of West Roxbury note, 7 per cent., ...	80,000 00
County of Hampden note, $6\frac{1}{2}$ per cent., ...	50,000 00
Cash in Treasury, ...	1,575 35
Total Fund, ...	$350,000 00

Annual Income of Fund at 6 per cent., ... $21,000 00

Two-thirds of this income are by law paid to the Treasurer of the College, and one-third to the Treasurer of the Institute of Technology.

Income of College from Endowment Fund, ...	$14,000 00
By the conditions of the gift, none of the income of the fund derived from the sale of land-scrip can be used for the erection or repair of buildings.	
The Hills Fund of $10,000 for the maintenance of the Botanic Garden is in charge of the College Treasurer, and at present yields an income of	500 00
Total Income from Funds, ...	$14,500 00

To this sum should be added the receipts of tuition and room-rent, amounting to $72 per annum for each scholar, and the receipts from the sale of the products of the farm and garden.

DR. MASSACHUSETTS AGRICULTURAL COLLEGE *in account with* NATHAN DURFEE, *Treasurer.* CR.

1872.			1872.		
Jan. 1,	To balance,	$16,995 38		To Salaries,	$18,551 00
	Income Hills Fund,	500 00		Board of Students,	4,249 51
	Income State Endowment Fund,	15,083 07		Expenses—Hills Fund,	916 42
	Interest on deposits,	390 00		" contingent account,	9,656 29
	Receipts from Students,	10,386 02		" term bill "	2,031 13
	Receipts from Farm Superintendent,	873 50		" botanical "	364 38
	Receipts from Gardener,	724 95		" farm "	7,313 54
	Receipts from Insurance,	1,501 63		Balance,	3,372 28
		$46,454 55			$46,454 55

Respectfully submitted,

NATHAN DURFEE, *Treasurer.*

I have examined the Treasurer's accounts, and find them correctly stated and accompanied by the proper vouchers.

HENRY COLT, *Auditor.*

SUMMARY OF METEOROLOGICAL OBSERVATIONS

For the Year 1872,

TAKEN AT AMHERST MASS.,

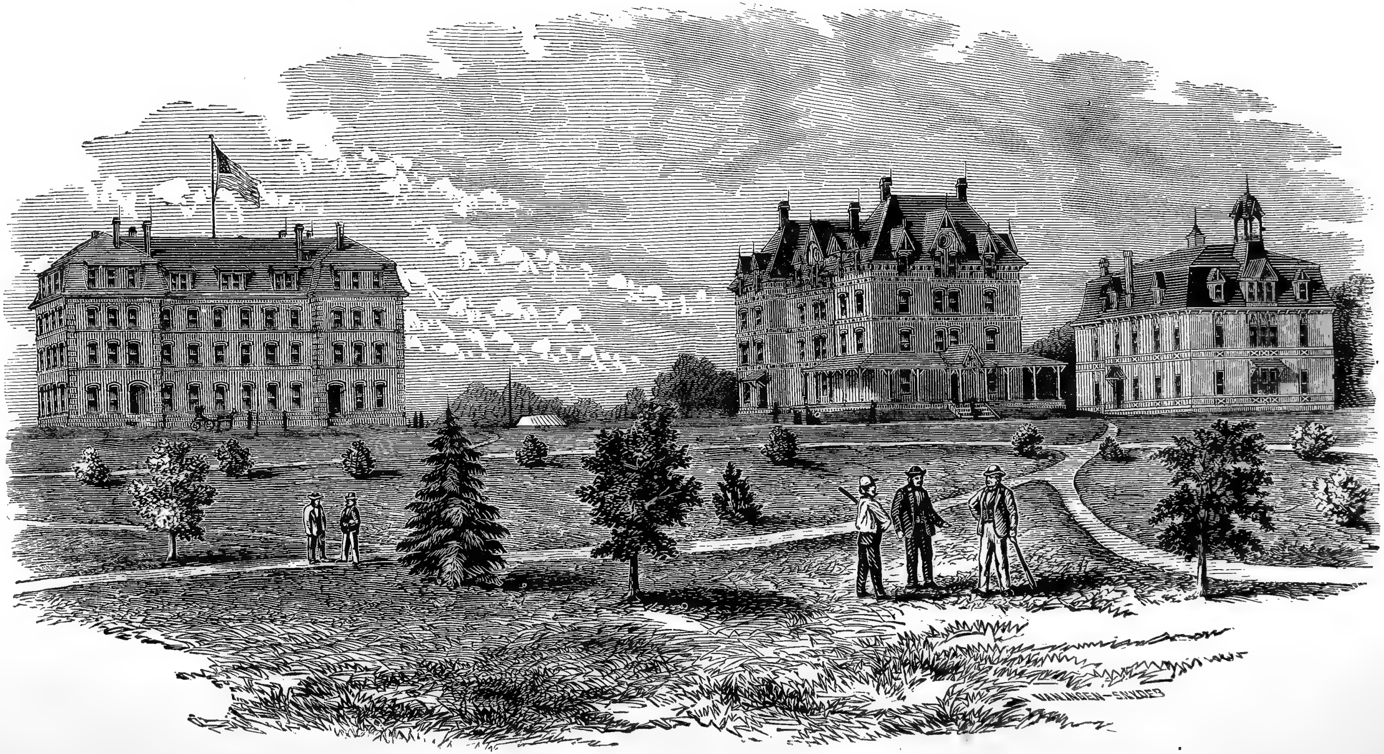
By Professor E. S. SNELL, LL.D.

Latitude 42° 22′ 17″. Longitude 72° 34′ 30″. Elevation above the sea level, 267 feet.

SUMMARY OF METEOROLOGICAL OBSERVATIONS FOR 1872.

MONTHS.	THERMOMETER IN THE OPEN AIR.			RAIN AND SNOW.		CLOUDS.	WINDS. PER CENT. OF TIME AND FORCE.				BAROMETER. BAROMETER HEIGHT REDUCED TO FREEZING POINT.			FORCE OR PRESSURE OF VAPOR, IN INCHES.			RELATIVE HUMIDITY OR FRACTION OF SATURATION.		
	Maximum.	Minimum.	Mean.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches.	Mean per cent. of sky.	Northwest.	Southwest.	Southeast.	Northeast.	Maximum.	Minimum.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
January, . .	42.9	2.5	25.11	1.507	3.0	46	67	4	13	16	30.264	29.229	29.669	.219	.027	.096	98	35	66
February, . .	50.0	–2.5	24.16	1.888	15.0	32	66	1	18	15	30.285	29.037	29.651	.226	.031	.088	100	29	64
March, . .	44.0	–4.8	25.27	2.870	15.5	47	74	3	12	11	30.183	29.071	29.657	.199	.020	.095	92	29	65
April, . . .	84.0	29.0	48.03	2.201	0.5	43	62	14	17	7	30.099	29.209	29.694	.383	.083	.175	98	20	60
May, . . .	84.1	47.3	59.14	3.110	–	47	48	13	27	12	29.984	29.199	29.641	.598	.141	.316	97	18	64
June, . . .	91.8	48.7	68.14	3.250	–	53	40	13	31	16	29.923	29.208	29.655	.906	.239	.522	98	35	77
July, . . .	91.7	59.1	72.64	7.066	–	50	37	14	40	9	29.932	29.391	29.655	.928	.361	.616	99	41	78
August, . .	88.8	52.9	71.60	5.280	–	57	33	15	49	3	29.986	29.298	29.732	.972	.282	.650	100	40	84
September, . .	88.5	39.5	61.70	6,197	–	63	33	9	46	12	30.044	29.399	29.770	.769	.221	.463	100	46	83
October, . .	69.0	29.9	48.24	3.639	–	54	40	18	25	17	30.290	29.183	29.784	.569	.128	.270	100	33	76
November, . .	54.0	10.0	36.43	4.483	12.0	52	48	23	17	12	30.208	29.121	29.647	.400	.054	.160	100	35	71
December, . .	40.3	–8.0	19.50	2.691	20.0	57	60	12	13	15	30.181	29.188	29.779	.218	.021	.087	100	38	73
YEAR, . .	91.8	–8.0	46.41	44.182	66.0	50	51	11	26	12	30.290	29.036	29.695	.972	.020	.292	100	18	72

NOTE.—Mean for 35 years: Thermometer in the Open Air, 46.57°; Amount of Rain or Melted Snow, 44.479 inches; Depth of Snow, 53 inches. Mean for 20 years: Cloudiness, 51 per cent. of sky. Mean for 29 years: Winds, Northwest, 51 per cent.; Southwest, 16 per cent.; Southeast, 24 per cent.; Northeast, 9 per cent. Mean for 30 years: Barometer Height Reduced to Freezing Point, 29.727 inches. Mean for 20 years: Force or Pressure of Vapor, 0.292 inch; Relative Humidity or Fraction of Saturation, 75.



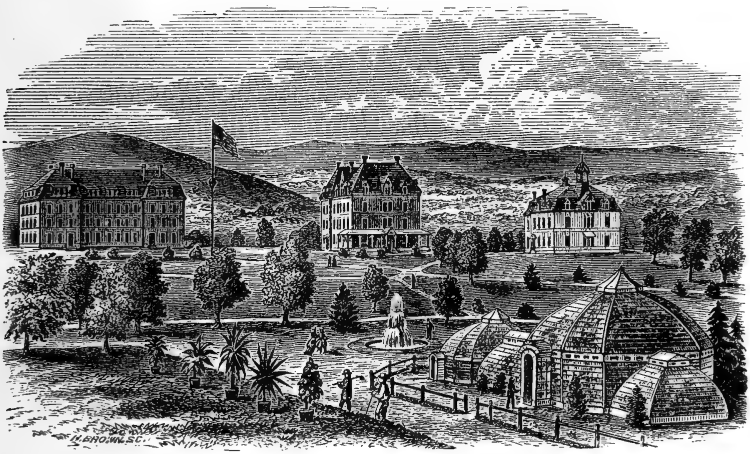
MASSACHUSETTS AGRICULTURAL COLLEGE.

SENATE...... ......No. 50.

ELEVENTH ANNUAL REPORT

OF THE

Massachusetts Agricultural College.



JANUARY, 1874.

BOSTON:
WRIGHT & POTTER, STATE PRINTERS,
CORNER MILK AND FEDERAL STREETS.
1874.

Commonwealth of Massachusetts.

EXECUTIVE DEPARTMENT, BOSTON, January 15, 1874.

To the Senate.

Herewith, for the information and use of the General Court, I have the honor to transmit the last Annual Report of the Trustees of the Massachusetts Agricultural College, with accompanying documents.

W. B. WASHBURN.

Commonwealth of Massachusetts.

AMHERST, JANUARY 9, 1874.

To His Excellency WILLIAM B. WASHBURN.

SIR :—I have the honor herewith to present to your Excellency and the Honorable Council the Eleventh Annual Report of the Massachusetts Agricultural College.

Very respectfully, your obedient servant,

W. S. CLARK, *President.*

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ANNUAL REPORT.

To His Excellency the Governor and the Honorable Council:—

The Trustees of the Massachusetts Agricultural College respectfully present the following Report for the year 1873.

The institution has been blessed with its usual prosperity, and under the judicious management of its able and devoted officers of instruction has accomplished much good. The farm and stock have steadily improved, the students have been obedient and faithful in their work, and some agricultural experiments and scientific investigations have been carried on with interesting and important results. The confidence of the numerous friends of the College in the wisdom of its plan of organization and its capacity for eminent usefulness was never greater than at the present time.

National Endowment.

Senator J. S. Morrill of Vermont, who will be gratefully remembered as the prime mover in the establishment of national schools of science and colleges for the promotion of education in agriculture and the mechanic arts, introduced a bill into the last Congress for their further endowment. This was rendered necessary by the defects in the Act of 1862, which made the grant to many of the States utterly inadequate for the object contemplated. This bill passed the Senate by a large majority, but failed at the very close of the session through a want of harmony among the friends of education in the two houses. It is again pending, and there is reason to hope that so just and beneficent a measure in the special interest of the industrial classes may be enacted at an early day.

This effort to secure a proper endowment for the national

colleges aroused a most extraordinary and unexpected opposition. Many of the leading educators of the country, who seem to have hitherto regarded these new institutions with silent contempt, became suddenly alarmed at their rising importance, and presidents of universities, both old and new, appeared at the national capitol, in person or by letter, to remonstrate against the proposed action of Congress. Some of these gentlemen were among the foremost champions of the modern system of education, which substitutes optional and scientific studies for required and classical courses, and there appears to be no rational explanation of their conduct in thus opposing additional aid to national schools of science which were already established. One of them even ventured to assert that Congress has no right to build up these institutions for industrial education, because of the injury they would do to those previously existing. He, however, is a foreigner, and therefore perhaps excusable for not understanding that the American people will never give the exclusive right to educate their sons to any sect, party or corporation, however respectable for its morality, or venerable for its antiquity, or arrogant in its assumptions.

These attempts to convince Congress that the noble enterprise contemplated by the original grant of more than nine million acres of public lands for the advancement of industrial education among the people was not only a mistake but even an act of injustice, had the natural effect of calling out quite a general howl of adverse criticism from those numerous editors and correspondents of newspapers who seem to delight in the Hibernian pastime of a free fight, and to adopt the familiar rule on such occasions of hitting whatever head is within reach. These hostile articles have generally contained such internal evidence of ignorance or malice or most unjustifiable expectations as to be worthy of no attention, yet it is to be regretted that they have evidently operated in a very injurious way upon the public welfare. The large majority of the people know nothing of the Massachusetts Agricultural College except what they read in the newspapers, and are, therefore, easily prejudiced against an institution which is designed solely for their good, and is in the main satisfactory to all disinterested persons who know the facts

concerning it. There are hundreds of influential men who, like the lamented Agassiz, were for years after its incorporation entirely sceptical in regard to the possible utility of such an institution, but who now are ready to unite in his magnanimous confession that he had been mistaken, and was glad to be convinced of the fact, and that the College was a complete success, and worthy a position among the scientific institutions of the world.

These words of high commendation do not mean that the College is perfect in all respects, or is accomplishing all it ought to accomplish. They merely affirm that, under all the circumstances, with the money it has, and the patronage it has, it is doing the best that can be done, and therefore deserves the confidence and support of every good citizen.

It is the earnest desire of the trustees and faculty that the College shall especially promote the agricultural interests of the Commonwealth, but it may be well to remind those who demand that every graduate shall be a farmer, that the Act of incorporation passed by the legislature of 1863 does not intimate that the accomplishment of this result is the mission of the institution. The language is as follows: "The leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in order to promote the liberal and practical education of the industrial classes in the *several* pursuits and professions of life."

It should, therefore, be distinctly understood that, while the most effort and the largest expense have been bestowed upon the agricultural department, the authorities of the College do not propose to require its graduates to engage in any particular business for life. The opportunity for acquiring a valuable education is offered to all the young men of the country, and if the farmers desire to have their sons trained in the best manner to pursue intelligently the profession of their fathers, let them patronize the College. If, however, there are others who wish to have their sons enjoy the advantages of scientific and literary culture under circumstances calculated to interest them in practical affairs, and to prepare them for a life of industry and usefulness, they have equal

rights with the farmers, and shall have equally cordial welcome.

If there be any failure in the matter of professional agricultural education, the blame cannot justly be imputed to the College, but must rest upon those farmers who fail properly to appreciate either the importance and advantages of their occupation, or the exceeding value of knowledge and mental culture, or else upon those persons who, by their unreasonable requirements, or false statements, prejudice the public mind to the great detriment of the Commonwealth.

It is altogether unaccountable how men, who profess to be lovers of the truth, friends of education and of humanity, and public-spirited citizens, can allow themselves to exert their influence against the interests of an institution founded by the government for the people. If it can be improved, let the proposed means and method be kindly stated. If its officers are not what they should be, let the facts concerning them be fairly discussed. If its course of instruction seem too elementary or too literary to any, let proper modifications be suggested. But let it be remembered that the College has been established to continue forever, that the good name of Massachusetts is inseparably united with it, and that its reputation ought to be as dear and sacred to every citizen of the State as that of his most intimate personal friend. Let it be borne in mind that the trustees have faithfully and anxiously labored to accomplish the difficult task assigned them, with no other compensation than the hope of usefulness, and that their efforts deserve at least respectful consideration.

Financial Condition.

The ordinary expenses of the College upon its present basis, which is as simple and economical as is consistent with the objects to be achieved, are about $30,000 per annum. The permanent cash fund in the State treasury is $233,333.33, yielding an annual income of $15,000. The receipts for tuition and room-rent amount to about $10,000 per annum, and cannot be increased to any considerable extent without additional buildings. Until, therefore, some further endowment be received, either from Congress, from the State, or from private individuals, there will be need of an annual appropria-

tion from the legislature of at least $5,000. There are also many permanent improvements which should be made, while some money is required every year for new books and apparatus, and to defray the necessary expenses of experiments for the advancement of science, and especially for the benefit of agriculture.

The fact that the College is the child of the State appears to be an obstacle in the way of securing donations from individuals, the largest gift during the past year being the sum of $1,000, from Hon. William Claflin, for the endowment of prizes to be awarded each year to those two members of the graduating class who may pass the best oral and written examinations in the theory and practice of agriculture. These prizes are to be called the "Grinnell Agricultural Prizes," in honor of George B. Grinnell, Esq., of New York.

It is to be regretted that the insufficiency of the present fund for the maintenance of the College renders it necessary to charge so large a sum for tuition, and it is earnestly hoped that either by an additional endowment from Congress, or by the establishment of free scholarships by individuals, it may soon be possible to aid the large number of indigent, but excellent, students who are now compelled for want of money either to forego the advantages of college education altogether, or to confine themselves to a special and imperfect course.

The Massachusetts Society for Promoting Agriculture sets a noble example to the other societies of the Commonwealth by maintaining four free scholarships, at an annual expense of $300.

No appropriation having been made by the legislature since 1871, the indebtedness of the College now amounts to $13,000.

Course of Instruction.

In the Tenth Annual Report a detailed statement concerning the education offered at the College and the several departments of instruction was given. The experience of another year suggests no material change in the views there expressed, or the general course of study. The officers are all desirous of raising the standard of admission as soon as circumstances will admit, so that the students under their training may be as mature as possible, and advanced in math-

ematics and languages as far as practicable. They would then be able to profit more by the excellent opportunities afforded for scientific study and investigation, and the results of the college course would be more satisfactory. The progress made by the large majority of the graduates during their four years of study is, in most respects, quite admirable, but, as in all other institutions, varies with their individual circumstances. The older and more talented and better prepared they are upon entrance, the more valuable is the education they acquire, and the greater their usefulness in after-life. While it is important that the standard of admission should not be so high as to discourage the farmers from attempting to educate their sons, there are obvious reasons for raising it as much and as soon as the popular appreciation of college education will permit. It may be argued, with some reason, that the more thorough and complete the attainments required for graduation, the larger would be the patronage of the institution and the greater its popularity. But the prevalent opinion among the people, whether learned or ignorant, that manual labor and agricultural pursuits are incompatible with much intellectual culture and extensive learning, seems to justify the plan temporarily adopted. When the farmer shall have discovered that knowledge is not only power but also pleasure and wealth, and that only large mental acquirements can command great influence and respect, it will be easy to elevate the standard of the entrance examination to a higher and more desirable point.

The Hon. George S. Boutwell, in a recent address, has stated some important truths respecting agricultural education. He says: "Other things being equal, the practical farmer who knows the most will do the best; but other things not being equal, a man who excels in wisdom in administration, may surpass a man of greater learning, or even one of greater knowledge of things. But do not allow this suggestion to lead you to place a lower estimate upon learning, whether general or professional; for culture of every sort gives us capacity to appreciate wisdom, and opportunity also for its exercise." And again, "Mere numbers will not give the body of American farmers, permanently, either power or position. They should be intellectual men, and their calling should be

made intellectual. Any calling that is followed by intellectual men is at once clothed with dignity, respectability and power. Ignorance is our common enemy. Farm labor, as labor merely, is not attractive. But to intellectual men the field of examination, of experiment, of investigation, of test, is as large and as inviting as that occupied by Agassiz and his associates."

Veterinary Department.

The only change in the faculty during the past year was caused by the decease of Prof. Henry James Clark, who had just become established in the chair of veterinary science, and was zealously occupied in the duties of his office. The public at large can with difficulty appreciate the loss to the College and to the world, resulting from the death of so accomplished a scientist in the very prime of life. The following sketch of the main points in his distinguished career may not be uninteresting.

He was born June 22d, 1826, in the town of Easton, Mass. His father was a clergyman, and afterwards resided many years in Brooklyn, N. Y., where the son received much of his early education. He took the degree of B. A., in 1848, at the University of New York City, and the degree of B. S. at Harvard University, in 1854. He was appointed assistant professor of zoölogy in Harvard University, in 1860; professor of natural history in the Agricultural College of Pennsylvania, in 1867; professor of natural history in Kentucky University, in 1869; and professor of veterinary science in the Massachusetts Agricultural College, in 1872. In 1856 he was elected a fellow of the American Academy of Arts and Sciences, and in 1870, an associate fellow of the same. In 1857 he became a member of the Boston Society of Natural History. In 1865 he was chosen a corresponding member of the American Microscopical Society; in 1866, corresponding member of the Essex Institute; and in 1868, correspondent of the Philadelphia Academy of Natural Science. In 1872 he was honored by an election to the National Academy of Sciences, an organization chartered by Congress and limited in membership to fifty of the foremost scientists of the country.

In 1863 Professor Clark delivered a course of lectures before the Lowell Institute, in Boston, and in 1865 published them under the title, "Mind in Nature," or "The Origin of Life, and Mode of Development of Animals." This was, perhaps, his most important work, and at once established his reputation throughout the scientific world. It was illustrated by more than two hundred microscopical illustrations, which were the result of his own original investigations in embryology and zoölogy. He was pronounced by Professor Agassiz to be the most skilful and reliable microscopist in the country, and the evidence of his ability may be seen in the admirable illustrations made by him for Agassiz's Contributions to the Natural History of the United States. He was an indefatigable worker, and contributed numerous articles to scientific periodicals and the transactions of learned societies. The Smithsonian Institution has now in press a work from his pen, and another valuable manuscript nearly ready for publication will be completed by a distinguished scientific friend.

Professor Clark married Miss Mary Holbrook, of Boston, who was a most devoted wife, and aided him greatly by her cheerfulness, economy and industry in bearing the trials incident to a limited income and failing health. An interesting family of four sons and three daughters still remains to be at once her care and comfort.

The fatal disease, which finally overcame the manly strength of a vigorous constitution, was the result of nervous prostration caused by overwork. Our lamented friend died July 1st, 1873, in the forty-eighth year of his age, and will long be deeply mourned by those who were familiar with his many estimable qualities.

Prof. Noah Cressy, M. D., of Middletown, Conn., has been elected as the successor of Professor Clark, and has already entered upon his duties. He has held the position of veterinary pathologist of the Connecticut Board of Agriculture, and has acquired the reputation of being a skilful practitioner of veterinary medicine. He is an enthusiastic student, with a valuable library and a cabinet of choice specimens of comparative anatomy, and is ambitious to excel in his chosen profession. There is reason, therefore, to expect that

under his intelligent guidance, many young men will acquire a far better knowledge of the proper treatment of our domestic animals, when disabled by injuries or affected by disease, than is now possessed by those who ordinarily undertake to relieve them.

An interesting lecture upon the importance of this department of the College and its relations to agriculture was recently delivered by Professor Cressy before the Massachusetts Board of Agriculture at Fitchburg, and may be found in the Annual Report for 1873–4.

Agricultural Department.

The superintendence of the college farm has continued in charge of Mr. John C. Dillon, whose report is appended to this and shows in detail his operations for the year 1873. It is the universal testimony of those who are conversant with the facts that the general appearance of the thoroughbred stock, the teams, implements, roads, barns and fields has been more satisfactory throughout the year than ever before.

Professor Stockbridge has given the instruction in theoretical and practical agriculture with his accustomed success. He has also begun a series of experiments upon the feeding of crops with special fertilizers in a purely chemical form, which have already afforded surprising results, and which will be continued for several years, so as to arrive, if possible, at some useful facts for the benefit of farmers.

Professor Goessmann has not only given the instruction in chemistry, but, with his usual remarkable industry, has done a vast amount of analytical work in determining the composition of commercial fertilizers in connection with his office of State inspector, the results of which will be found in the Annual Report of the Board of Agriculture for 1873–4.

Appended to this Report will also be noticed his final paper upon the subject of beet-sugar, giving the results of numerous experiments on the college estate, as well as in New York and Canada. From his statements it will be seen that beet-seed of the best quality has been raised in Amherst from roots of the Imperial variety, grown in 1872 from seed imported from Saxony. The effects of various fertilizers and modes of culture upon the size and quality of the beet are also illustrated by the experiments described.

Little as the work accomplished in the laborious investigations upon the sugar-beet at the College during the three years past may be appreciated now, we venture the opinion that it will at no distant day be acknowledged as of the utmost importance and value to the agricultural interests of Massachusetts.

Botanical Department.

The Durfee plant-house, the nursery, the vineyard and the practical operations in the horticultural department generally, have been under the supervision of Prof. S. T. Maynard, who has also given instruction in the use of the microscope and in fruit-culture.

A large number of rare and costly plants have been imported from England at the expense of the Hills fund, and several new species, interesting in an economical point of view, have been presented by William Saunders, Esq., of the Agricultural Department in Washington.

The specimens in the plant-house represent about one thousand species or important varieties, and are in excellent condition. One of the most remarkable among them is the immense variegated century-plant or *Agave Americana*, the leaves of which measure eight feet in length. This was kept for twenty-five years by President Edward Hitchcock, and is now thirty-five years old. It has grown very rapidly the past season, and will doubless reach maturity and blossom within a brief period, possibly during the next summer. This species is monocarpous, and dies after flowering once. Under favorable circumstances, in warm regions, it matures in seven years, but as ordinarily treated, it requires from fifty to one hundred years.

Hon. Marshall P. Wilder has presented a collection of plants, and many specimens of fruits carefully named, which have been modelled for the botanical museum. Among the plants was a fine seedling camellia, which he has raised and named "President Clark." It is a cross of *Camellia Floyii* on *C. Middlemist*, and the flowers are of great size, fine crimson color, with some variegation of white, especially towards the centre, semi-double, and borne upon stout twigs, which are furnished with immense dark green and glossy foliage.

Under the direction of Professor Maynard, the junior class has done a large amount of work in preparing the ground for planting the Massachusetts garden, which is intended to contain all the indigenous trees, shrubs and herbaceous plants of the State, so far as they can be made to thrive in the locality selected. This is on the hill, east of the plant-house, and includes the grove south of the vineyard. Under the shade of large chestnuts and oaks is a swampy place where a pond can be easily formed to receive the aquatic species. Numerous roads and walks have been laid out, and much grading done in preparing beds. Many stumps and superfluous trees have also been removed, and for a very moderate expense the garden may be made quite attractive and useful.

A plantation of several hundred Norway spruces, Scotch larches, Scotch pines and Austrian pines has been set on the steep side-hill west of the vineyard, which is designed as a shelter to the vines, an ornament to the estate, and an experiment to determine the adaptation of these species of hardy evergreens to cover with useful timber the somewhat barren hills of Massachusetts.

About two acres of land on the summit of the hill, east of the plant-house, have been subsoiled to the depth of fifteen inches, and will be planted as a pinetum with native and foreign coniferous trees as soon as practicable.

Several thousand trees and shrubs of various species have been set in the nursery the past season, and many, which were imported from England several years ago, have been removed to other places for the adornment of the estate or for sale.

The vineyard, of about two acres, has been well kept, and the vines, of ten different varieties, are healthy and vigorous. They are now all laid upon the ground, with a light covering of earth, and will doubtless yield abundant returns another year. Trellises of a very substantial sort have been put up where they did not already stand. The posts are of chestnut, eight feet long, and six inches square at the large end. The wires are of galvanized iron, number fifteen in size, and are placed four on each post.

The most pressing wants of the horticultural department are a cold grapery and an orchard-house. His Excellency Governor Washburn has generously given the requisite glass

for these structures, but a few hundred dollars are wanted for providing the necessary masonry.

The fund of fifty thousand dollars, which must be secured before the work of planting the botanic garden can safely be undertaken, has not yet been furnished, notwithstanding the worthiness of the object and the often repeated solicitations for it. So important a measure for the benefit of the College and the advancement of science must sooner or later be accomplished, and it is hoped some wealthy friend will speedily establish such a fund, the income of which will supply the means to pay indigent students by whom the necessary work for keeping the garden in order may be done.

The students have evinced an unusual interest in botany during the past year, and have made larger and more excellent herbariums than ever before. This was owing to the fact that more time has been devoted to the study, and also to the stimulus of the Hills prizes of fifteen and ten dollars respectively for the best and second best collections of plants, regard being had to the number and quality of specimens, neatness of mounting, correctness of names and arrangement, and the catalogue accompanying each. Some of the herbariums contained more than five hundred species, and one reached the very large number, for one season in this locality, of five hundred and eighty-seven. The successful competitors were Edward H. Libby and Edward E. Woodman.

An extensive series of investigations was carried on during the spring upon the circulation of sap in the sugar-maple and other species of trees. A summary of the results will be found appended to this Report. The presentation of this subject before the meeting of the Board of Agriculture at Fitchburg, in December last, elicited from Professor Agassiz the extraordinary statement that the production of this one paper was an ample return for all that had been expended on the College; while Dr. George B. Emerson, the celebrated author of the "Report on the Trees and Shrubs of Massachusetts," has fully endorsed the "apparently extravagant commendation of our lamented Agassiz," and added that "under the feeling which it produced in him he would, if he had a hundred thousand dollars to give, send it all to the College at once."

These remarks are here repeated in the hope that the im-

portance of providing means for systematic scientific investigations and experiments for the advancement of knowledge and the improvement of agriculture and horticulture, will thereby be rendered more apparent to those who have the ability to secure them for the College.

Anniversary Week.

The exercises of the third anniversary of the College were of an interesting and satisfactory character. A large number of the overseers and trustees were present and evidently interested in the proceedings of the week.

The successful competitors for the Farnsworth Rhetorical gold medals were P. M. Harwood, of the sophomore class, and C. W. McConnel, of the freshman class; while the silver medals were awarded to L. K. Lee, of the sophomore class, and J. E. Williams, of the freshman class. The prize declamations occurred Monday evening, July 14th.

The public examinations of the several classes before the committee of the Board of Agriculture, were held on Thursday, the 15th of July. In the evening was the president's reception, which was attended by His Excellency Governor Washburn, Senator Justin S. Morrill, several members of the Executive Council, many of the Board of Agriculture, some of the trustees of the College, and the alumni and members of the graduating class and their friends.

On Wednesday, July 16th, the examination of the graduating class in agriculture took place in the presence of the Board of Agriculture. After this, the battalion of Massachusetts Agricultural Cadets was reviewed by His Excellency the Governor, in the presence of a large crowd of spectators.

In the afternoon, the address before the Social Union was delivered by Hon. Justin S. Morrill, of Strafford, Vt. His subject was "Some of the Opportunities and Perils in the Pathway of the Young Men of America." The address was full of excellent suggestions, and listened to by a large and intelligent audience gathered in the military hall.

The literary oration of Senator Morrill was followed by brief addresses from four members of the graduating class. Frank W. Wood spoke of "The Object of Agricultural Colleges"; Seth S. Warner, on "Practice with Science"; Charles

Wellington, on "The Study of Natural History"; and John B. Minor, on "The Influence of the Arabs in Europe," with the valedictory addresses.

The diplomas were then presented to the graduating class by Governor Washburn, who also delivered a short address, complimenting the College, and expressing his gratification with what he had seen, especially in the military department, which he regarded as of very great importance.

The exercises of the anniversary were closed by a very happy extempore address from Hon. Marshall P. Wilder.

Conclusion.

There has been a great deal of discussion during the past autumn in regard to the general effect of the College upon the students who attend upon its instructions. For the information of those desiring to know the facts a catalogue has been prepared of the present occupation and residence of all past students, whether in the regular or special classes. It is quite satisfactory to observe that as many are now engaged in agricultural pursuits as expressed their intention of doing so when they came to college, so that the assertion that the effect of the education is to turn young men away from agricultural pursuits is totally false. About seventy out of two hundred and thirty-four students are known to be engaged in farming or kindred business, and nearly all who have been at the College are now engaged in some industrial calling. Thus it appears that the institution is truly accomplishing its appointed mission in educating young men for the more practical pursuits and professions of life. Quite a number of those who are now engaged in engineering and other occupations have expressed the intention of adopting agriculture as a profession, as soon as they have obtained money enough to buy and stock a farm.

It is perhaps hardly to be expected that farmers, who have not themselves enjoyed the advantages of scientific and literary training, should fully appreciate the numerous benefits which their sons might derive from a college course. Yet no intelligent man doubts the inestimable value of education to its possessor, or the increased power and influence which it enables him to exert in society. As a pecuniary investment

merely, a liberal education is the safest and most productive which it is possible for a father to make for his son.

Dr. H. P. Wakefield, president of the Eastern Hampden Agricultural Society, in a recent admirable address upon "Agriculture from a New England Stand-point," says:—

"I want to urge on every farmer to make the effort to be a better one. I care not how good you may have been, you have not reached perfection. There is room for improvement. You have toiled with your muscles, now put more brains into your work. Physical labor is a power, but combine it with brains and you increase it a thousand-fold."

Referring to the College, he adds:—

"At this institution are many young men pursuing studies calculated to prepare them to compete successfully with other young men in the various occupations and professions of life, and at the same time gaining practical experience in the laboratory, in the lecture-room, in the barn and in the field. I have had occasion during the past season to know something of this matter, having been delegated by the State Board of Agriculture to examine the College and the farm. I have seen the students in the recitation-room, at work with the microscope; ascertaining the pressure of sap in different trees in spring-time; analyzing soils and flowers; on parade, and at work in the fields with their teachers, the same as other boys in a farming community.

"I am the son of a farmer, bred and reared on a farm, and, by the exertions of an honored sire, who, feeling the want of an education, determined that his son should have a better chance than himself, was enabled to graduate at Amherst, and yet I would to-day give the preference to the Agricultural College rather than the Classical, believing the former can fit a young man to make his way and his mark also, in any profession or pursuit, and at the same time establish in him habits of manual labor, and also give him a knowledge of a business that a large class of persons, especially those who in boyhood have tasted its sweets, wish to engage in, in the declining, if not in the earlier, years of life."

While almost every individual is inclined to imagine his own occupation to be more irksome and unprofitable than others, it seems to be the misfortune of agriculture to be lightly esteemed by all classes of people. The very fact, that it is so

safe and so remunerative that the least intelligent and the least educated persons subsist comfortably by it, proves its superiority to other professions, and there can be no question that agriculture offers a most favorable field for intelligent enterprise and business capacity. Professor Stockbridge asserts that the farming operations of the United States yield a return of at least fifteen per cent. on all the capital engaged in them, while Senator Boutwell declares every farm-crop to be exceedingly profitable, the reason why farmers generally have so small an income being simply the smallness of their capital. He says, "Let any farmer state an account with each particular crop, and he will find his per cent. of profit so large that he would become a millionaire in five years if his aggregate business were one-tenth as large as that of the leading merchants and manufacturers of the country."

Before another generation has passed from the earth, both education and agriculture will have risen greatly in the estimation of men. Happy will the boys of to-day be in their declining years, if they secure in their youth knowledge and culture enough to enable them to keep abreast with the wonderful progress of the world, and if they then enjoy possession of a comfortable homestead with the abundant improvements and adornments which are daily becoming more common, and with that greatly enhanced value which inevitably accrues to landed property with advancing time in all countries of permanent wealth and refinement.

The officers of the Massachusetts Agricultural College are earnestly and hopefully striving to elevate both the farmers and the farming of the State, and to increase the productiveness of the soil and the attractions of rural life. They believe these results will richly benefit all classes of the community, and therefore appeal with confidence to their fellow-citizens for liberal support, kindly sympathy and just criticism.

Respectfully submitted,
By order of the Trustees,

W. S. CLARK, *President.*

SUMMARY OF OBSERVATIONS

ON THE

CIRCULATION OF SAP.

By PRESIDENT W. S. CLARK.

4

CIRCULATION OF SAP.

The want of sufficient data for a satisfactory determination of the manner in which plants absorb and distribute through their various parts the nutrient materials by the assimilation of which they grow, led to the following investigations. Appreciating the difficulties which oppose researches into the structure and functions of living beings, and especially of those belonging to the vege able kingdom, we thought best to begin our inquiries at points where information was readily afforded, intending to proceed with them as far as circumstances would permit. The familiar facts, that sap would flow from wounds in the wood of certain trees in spring, that the maples yielded a large amount of cane-sugar, and that the peculiarities of the season affected the quantity and the quality of the flow, seemed to indicate the desirableness and propriety of observations upon the amount, pressure and composition of the sap which might be obtained from different species of woody exogens. The amount of labor involved in such investigations, even after a statement of the facts, can hardly be appreciated except by those who have been engaged in similar undertakings.

The task of making, adjusting and repairing six mercurial gauges, used in determining the pressure exerted by the sap of different trees, and of recording most of the observations, was cheerfully undertaken and most faithfully performed by Prof. S. H. Peabody, who also prepared with great skill a chart representing upon a uniform scale the pressure exerted by the various species during every hour of the season. He visited the gauges under his charge several times daily for many weeks. All of them were necessarily at considerable distance from his residence, and one was reached by a perpen-

dicular ladder forty-two feet in height, so that taking observations, especially in dark and stormy nights, was far from a pastime.

Prof. Levi Stockbridge recorded with great care and interest the fluctuations of the mercury in the gauge upon the sugar-maple during a period of ninety days.

Prof. C. A. Goessmann took the specific gravity of a large number of specimens of sap from many species of trees, and from the same trees at different times, and applied chemical tests for the determination of sugar and other ingredients.

Mr. Albert T. Wakefield, of the senior class, devoted much time for some weeks to tapping the various trees of the forest, collecting specimens of sap for analysis and weighing the daily flow from the several trees under observation. As these were widely scattered over the college estate, their visitation necessitated a somewhat extended journey at a season when people generally do not walk the fields for pleasure.

When it is further added, that over sixty species of trees and shrubs were tapped, most of them several times, and that the extreme points where observations were made were more than five miles apart, some conception may be attained of the work required for the acquisition of these few facts.

For a detailed account of the results attained, and a discussion of the general subject of the circulation of sap in exogenous plants, the reader is referred to the Report for 1873–74 of the Massachusetts Board of Agriculture. The following synopsis must here suffice.

It was found, in the first place, that the great majority of trees and shrubs do not bleed from wounds in the wood at any season of the year, and that the few species in our latitude, which exhibit this phenomenon at all, do so to any considerable extent only when deprived of their foliage. No peculiarity of structure or habitat has yet been detected which accounts for this extraordinary difference among them. The soft and spongy wood of the willow and elm, which often grow in moist ground, might be deemed specially suited to absorb and pour forth water before the expansion of their leaves or flowers in the spring; but the wood appears to contain no unusual amount of sap at that time. Of more than sixty species of trees and shrubs tested by boring a three-quarter-inch hole,

usually to the depth of two inches, into the sap-wood near the earth, only those of the following genera showed any tendency to bleed, viz.: *Betula*, which includes the birches; *Acer*, the maples; *Vitis*, the vines; *Ostrya*, the hornbeam; *Juglans*, the walnuts. The genus *Carya*, to which belong the hickories, sometimes exudes a very little, and possibly the *Fagus* or beech, and *Carpinus*, the hop hornbeam, may do the same, though no opportunity offered for testing them satisfactorily. On the 19th of March, when the ground was still covered with snow, but free from frost, fourteen species of the common forest-trees were tapped, and nearly all those which were subjected to experiment were tapped on the 21st of April, and again on the 30th of the same month.

It was found that each species of those which flowed had its own time of beginning, when it seemed to awake from its winter's repose, that the flow steadily increased in quantity and force, as indicated by the weight of sap and the pressure on a mercurial gauge, until it reached its maximum, and then gradually declined; and that the composition of the sap of the several species differed remarkably, according to the date of the flow, and especially the time of its beginning. This singular periodicity, peculiar to every species, demonstrates that the absorption of water by the rootlets is not caused by osmose, or any other mere physical force, but is the result of the specific life which imparts to every plant its distinctive characteristics.

The sugar-maple begins to flow in October, reaches its maximum about the first of April, and ceases about the first of May. The black-birch begins to flow the last of March, attains its maximum the last of April, and stops about the middle of May. The wild summer grape-vine commences about the first of May, arrives at its maximum of flow and pressure about the 25th of May, and ceases early in June. This difference in the season of flowing is of course accompanied by a corresponding variation in the temperature of the soil and the atmosphere, and, very naturally also, in the chemical condition of the sap. Thus the principal ingredient of maple-sap is cane-sugar, that of birch-sap is grape-sugar, and that of vine-sap is mucilage or gum.

These three carbo-hydrates, cane-sugar, grape-sugar and gum, are doubtless chiefly formed out of the starch which descended

to the root of the plant and was deposited in its cells, or those of the stem, as the result of the previous season's growth. It seems probable that these transformations occur in the sap after the period of its spring activity begins, and in the following order, viz.: insoluble starch becomes soluble gum, gum becomes uncrystallizable grape-sugar, and this, under favorable circumstances, becomes cane-sugar. Why, then, do we find cane-sugar in the maple and not in the birch, and why only gum as the chief ingredient of the sap of the vine and of those trees which do not acquire the power of active absorption until the development of their buds? Possibly because these transformations require time, and the maple alone is gorged with sap during the six months intervening between the fall of the leaf and the beginning of growth in the spring. This affords ample time for chemical changes, and seems to have some connection with the fact, that the maples are the only indigenous trees from which crystallizable cane-sugar can be profitably extracted.

For a similar reason, since we find the birches filled with sap for several weeks before a bud begins to expand, we may reasonably expect the formation of grape-sugar at least, in them, and in the north of Europe a sweet syrup is obtained by the evaporation of their sap. The spring sap of the vine at the beginning of its motion about the first of May seems to contain no sugar of any kind, but three weeks later it often acquires a sweetish taste, and then we may find a trace of grape-sugar. At this period, the beginning of vegetable growth is attended by the rapid exhalation of the water of the crude sap and the assimilation of its gum in the formation of cellulose, and this is precisely the transformation which ordinarily occurs in plants at the beginning of the vegetating season.

In regard to the circumstances which affect the flow of sap from the sugar-maple, the following results have been arrived at. A careful comparison of the daily weight of sap from several trees, with the meteorological observations of the same period, conclusively proves that while the general flow corresponds with the season, rising to a maximum and then declining, yet the daily and hourly flow varies with the weather. The most unfavorable weather is that which is either steadily and severely cold or uniformly warm and

foggy, while the best sap-days are such as are bright and warm at mid-day, but preceded by freezing nights. Such variations of temperature as affect the flow of maple-sap are most likely to occur when the ground is covered with snow, because the heat of the sun during the day cannot then accumulate to moderate the cooling influence of the night. The most probable explanation of the effect of these alternations appears to be that the outer tissues of the tree are partially emptied of their contents by the contracting influence of cold, the sap being driven into the heart-wood of the higher parts of the trunk. Meanwhile, absorption goes on as usual underground, and thus, when relief is afforded by the expansive influence of the heat of the sun, the sap rushes back to the surface and flows abundantly.

Observations by Biot, in France, on the poplar, and by Nevins, in Ireland, on the elm, seem to show that the sap is thus forced by freezing weather from the outer wood and branches into the hearts of trees.

To determine whether sap would run from the heart-wood of a sugar-tree, a piece of gas-pipe was sharpened and driven snugly into a hole six inches deep. From this spout the flow was regular and long continued, but not quite as abundant as usual. This proves that the spring sap usually enters and fills the heart-wood as well as the alburnum.

Another tree was selected, and a piece of bark five inches long and three inches high was removed from the outer layer of wood, and a piece of sheet-iron driven into the bark below to catch the sap, which flowed very profusely but stopped very early. The tree, from the heart of which the sap was taken as above described, flowed eleven days longer than the similar one from which only a piece of bark was removed, but the latter afforded twelve pounds more of the fluid.

In the case of a tree tapped on the north and south sides at the same level, it was found that the north spout yielded daily about twice as much sap as the south spout, and continued to flow nearly two weeks longer. The tree was tapped March 19th, and yielded seventy pounds of sap, containing two and a half pounds of sugar.

In order to discover whether the sweetness of the sap was the same in all parts of the tree, a spout was inserted into a healthy

maple, which had never been tapped, at the usual height, and fifty feet above this another spout was set into the trunk where it was about five inches in diameter. A limb thirty-five feet from the ground was also cut where it was one inch in diameter. In seven hours the lower spout had bled six pounds of sap, the limb, two ounces, and the upper spout, not a drop. Similar experiments on different trees showed that the sap flowed most freely within twelve feet of the earth, and that the flow diminished rapidly above this height.

This fact corresponds with the curious results obtained in observing the pressure of the sap as indicated by the mercurial gauge, which seem to show that the flow is caused by the absorbent power of the roots forcing water into the tree. The rapidity of the bleeding or weeping, as the Germans say, is modified by the season, the temperature, and the time which may have elapsed since a previous flow.

It appears evident, therefore, inasmuch as most trees will not bleed at any time, and as even in the maple the sap rarely rises more than twenty feet from the ground during the spring flow, that the development of leaf and flower buds is not usually affected by any mechanical pressure of the sap forced into them from below. Their vitality is stimulated to activity by the genial influence of the sun, and their growth is, in its beginning, caused by the assimilation of organic substances accumulated during the preceding season of vegetation.

Experiments upon the roots of maples proved that sap flowed from both ends of a cut root, and that it all contained sugar.

In regard to the amount of sap yielded by the sugar-maple and its percentage of sugar, further observations are needed. The largest flow during any one day last spring from a healthy shade-tree of this species, measuring six feet and five inches in circumference, occurred March 23d, and amounted to ten pounds and three ounces from two spouts. A similar tree, however, bled from two orifices on the 16th of December, 1873, sixteen pounds and seven ounces of moderately sweet sap, from which excellent sugar was made. On the 7th of November sap was gathered from the latter tree, which was found to contain only about one-half as much sugar as was observed in that which flowed last March. Whether the total

amount of sugar obtained from a tree can be much increased by multiplying the number of spouts inserted into it, we have not determined, though Mr. Parker D. Hubbard, of Sunderland, an experienced sugar-maker, has given the opinion that it cannot. His custom is to bore two half-inch holes about two inches in depth into ordinary trees, while four spouts and two buckets are used in the case of very large trees.

Among the interesting facts relating to this subject in Emerson's Report on the Trees and Shrubs of Massachusetts, are the following: A tree in Bernardston is said to have yielded a barrel of sap in twenty-four hours, and another in Leverett one hundred and seventy-five gallons in one season. The average annual product of sap from the sugar-maple is said to be from twelve to twenty-four gallons, and the amount of sugar from two to three pounds. Instances are given, however, in which the yield from a single tree has exceeded thirty pounds in one season.

Sugar may also be made from the sap of other species of maple, which is said to be only half as rich as that of the *Acer saccharinum*. The sugar from the *Acer dasycarpum*, or silver-leaved maple, is very white and well flavored, and is made in considerable quantity in some of the Western States.

Of late years much attention has been given to improved methods of collecting and evaporating sap, so that the sugar is greatly superior, at least in the older States, to what it was formerly. When carefully boiled down in evaporating pans, a white insoluble sediment or incrustation is deposited from the syrup. This was found on analysis by Professor Goessmann to consist of phosphate of lime and magnesia, which was held in solution by the sugar in the crude sap and precipitated by boiling.

The total amount of maple-sugar manufactured annually in the United States is less than one per cent. of the sugar product of the world, and, according to the census of 1870, amounted to 28,500,000 pounds, besides 921,000 gallons of syrup. This is nearly one-third less than the amount returned in the census of 1860.

There seems to be no good reason for believing that the loss of the small amount of sugar and mineral matter removed from a tree by tapping has any appreciable effect upon its

growth or vigor, and the escape of the water before the expansion of the leaves must be equally innocuous. Dr. Jabez Fisher, who has had a large experience in the cultivation of the grape, affirms that bleeding in the spring does not exert the slightest influence upon the vine. In order to determine this point he selected fifty Concord vines in his vineyard, and pruned one every day from the first of May until the young shoots were well grown, and so demonstrated to his satisfaction that it made no difference when vines were pruned, provided it be done before the development of the new growth.

The birches seem to exceed all other trees in the amount of sap which they yield; and the enormous pressure which they exert upon the gauge. Four species, the black, the yellow, the paper, and the gray or white birch were tested, and the daily flow of sap weighed. They were all tapped, March 19th, but did not bleed till the 25th, from which time they flowed with regularly increasing amounts till they reached the maximum of about fifteen pounds per diem from one spout for each species. This was the last of April, soon after which the leaves began to expand and the flow to diminish.

The hornbeam did not flow when tapped, April 21st, but on the first of May bled about ten pounds of nearly tasteless, turbid sap. On the 3d of May it reached its maximum of twelve pounds and six ounces from one orifice, and slowly declined in amount after this date.

The wild vine afforded eight ounces of nearly tasteless, transparent sap, May 26th, and this was the largest amount for any one day. It bled through the entire month of May a few ounces daily.

It only remains to state in a few words the surprising results obtained by the application of mercurial gauges to the sugar-maple, the black-birch and the grape-vine. Observations were made on one or more guages several times daily, and occasionally every hour of the day and night, from the 1st of April to the 20th of July.

A gauge was attached to a sugar-maple, March 31st, which was three days after the maximum flow of sap for this species, so that further observations are required earlier in the season to complete the record and determine with certainty the maximum pressure which it exhibits in the spring. Of the record

made, the following facts are specially interesting: first the mercury was subject to constant and singular oscillations, standing usually in the morning below zero, so that there was indicated a powerful suction into the tree, and rising rapidly with the sun, until the outward pressure was sufficient to sustain a column of water many feet in height. Thus at 7 A.M., April 21st, there was a suction into the tree sufficient to raise a column of water 25.90 feet. As soon as the morning sun began to shine on the tree, the mercury suddenly began to rise, so that at 9.15 A.M. the pressure outward was enough to sustain a column of water 18.47 feet high, a change represented by more than 44 feet of water. On the morning of April 22d the change was still greater, requiring for its representation 47.42 feet of water. These extraordinary fluctuations were not attended by any peculiar state of the weather, and happened twelve days before there were any indications of growth to be detected in the buds. These observations are believed to be quite new, and as yet inexplicable, but will receive further attention another spring.

The maximum pressure of the sap for the season was observed at 10 A.M., April 11th, and was equal to sustaining a column of water 31.73 feet high. This was an excellent sap-day, considering the lateness of the season. There was noticed a general correspondence between the flow of sap in other maples and the pressure on the gauge.

After April 29th the mercury remained constantly below zero, day and night. During the month of May there was a uniform suction equal to about eight feet of water, and the unaccountable feature of this fact is, that though apparently produced by exhalation from the expanding leaves, it remained the same, day and night, for several weeks. In June the suction gradually lessened, and finally disappeared, the mercury standing steadily at zero.

On the 20th of April two gauges were attached to a large, black birch, one at the ground, and the other thirty feet higher. The next morning at six o'clock the lower gauge indicated the astonishing pressure of 56.65 feet of water, and the upper one, of 26.74 feet. The difference between the indications of the two gauges was thus 29.92 feet, while the actual distance between them was 30.20 feet, so that it

corresponded almost exactly as if they were connected by a tube. In order to learn whether the same principle would prevail if the upper gauge was moved, it was raised twelve feet higher. The same correspondence continued through nearly all the observations of the season, notwithstanding the gauges were separated by 42.20 feet of close-grained birch-wood.

At 12:30 P.M., April 21st, a hole was bored into the tree on the side opposite to the lower gauge, and at the same level. Both gauges at once began to show diminished pressure, while sap issued freely from the orifice. In fifteen minutes, one pound of sap having escaped, it was found that both gauges had fallen equal to 19.27 feet of water. Upon closing the hole the gauges rose in ten minutes to their previous level, showing that the rootlets had re-absorbed in that brief period the sap which had escaped from the tree, notwithstanding the enormous pressure already existing.

A stopcock having been inserted into the hole opposite the lower gauge, it was found that the communication between it and the two gauges was almost instantaneous, which appears to prove that the tree was entirely filled with sap, exerting its pressure in all directions as freely as if standing in a cylindrical vessel more than sixty feet in height, as indicated by the lower gauge. The sap-pressure continued to increase until, on the 11th day of May, it represented a column of water 84.77 feet in height, which is believed to be the highest pressure of vegetable sap ever before recorded.

The buds of the birch now began to expand, the pressure of the sap to diminish, and the oscillations of the mercury to become more decided and regular than before. The upper gauge ceased to vary May 14th, remaining stationary at zero. The lower one declined slowly and varied greatly, but did not fall below zero until May 18th. On May 27th it also became stationary at zero. The suction manifested by the birch was very little, never exceeding nine feet of water, and continued only for a few days.

To determine, if possible, whether any other force than the vital action of the roots was necessary to produce the extraordinary phenomena described, a gauge was attached to the root of a black birch-tree, as follows: The tree stood in

moist ground, at the foot of the south slope of a ravine, in such a situation that the earth around it was shaded by the overhanging bank from the sun. A root was then followed from the trunk to the distance of ten feet, where it was carefully cut off one foot below the surface, and a piece removed from between the cut and the tree. The end of the root thus entirely detached from the tree, and lying in a horizontal position at the depth of one foot, in the cold, damp earth, unreached by the sunshine, and for the most part unaffected by the temperature of the atmosphere, measured about one inch in diameter. To this was carefully adjusted a mercurial gauge, April 26th. The pressure at once became evident, and rose constantly with very slight fluctuations, until, at noon on the 30th of April, it had attained the unequalled height of 85.80 feet of water. This wonderful result showed that the absorbing power of living birch rootlets, without the aid of any of the numerous helps imposed upon them by ingenious philosophers, such as exhalation, capillarity, oscillation, dilatation, contraction, etc., etc., was quite sufficient to account for the most essential of the curious phenomena connected with the circulation of sap. Unfortunately, in an attempt to increase the capacity of the gauge, the bark of the root was injured, and this most interesting experiment terminated. There can be little doubt that future trials, carefully conducted with suitable apparatus, will achieve even more marvellous results.

The original experiment of applying a mercurial gauge to the grape-vine, first tried by Rev. Stephen Hales, of England, one hundred and fifty years ago, was repeated, May 9th, and a pressure of 49.52 feet of water obtained, May 24th. This is six and a half feet higher than was observed by Hales. The peculiar features of the pressure of the vine-sap are: its lateness in the season; its apparent independence of the weather; its uniform and moderate rise, day and night, to its maximum; its very gradual decline to zero without any marked oscillations, and its constant and almost unvarying suction of from 4.5 to 6.5 feet of water, manifested from June 20th to July 20th, when the observations ceased.

In conclusion, we may as well admit that life is still a special force and not to be resolved into any other sort or combination

of attractions or repulsions, whether called electricity, or osmose, or any other name. There is obviously need of much more investigation and definite knowledge concerning the phenomena of vegetable nutrition and development, and it may be well to remember that we are everywhere surrounded by objects for scientific research, demanding our utmost talent, patience and skill, but sure to give ample and profitable results to every intelligent and earnest inquirer.

Explanation of Plates.

Figure 1 shows the mode of constructing the mercurial gauge and attaching it to a tree. At A is a stopcock, screwed firmly into the sap-wood, to which the glass-tubing is connected by a metallic coupling. The gauge is securely fastened to a scale, which may be inclosed in a box. The tube on the right may be lengthened, and mercury added should the pressure necessitate it. When the mercury stands at the same level in both sides of the inverted siphon, as at B, it is said to be at zero. In taking observations the difference in the number of inches of mercury in the two sides is to be noted, and this will indicate the pressure or suction, according as it is observed in the right or left side of the bent tube. In recording, the minus sign is prefixed to indicate suction into the tree.

Plate I. represents the variations of pressure, as indicated by the mercurial gauges on the 21st of April, 1873, observations having been taken every hour from 12 A.M. to 12 P.M. Every vertical line marks an hour, and every horizontal line an inch on the column of mercury. Zero represents the point where there is neither pressure outward from the tree nor suction inward.

The line A shows the record of the sugar-maple, which at midnight exhibited a suction equal to –6 inches, and at 7 A.M. had increased this to –22.9 inches. As soon as the sun warmed the tree the mercury began to rise, and at 9.15 A.M. had reached 16.3 inches. Then it declined very gradually, till at 12 P.M. it was at –3 inches. The temperature at 7 A.M. was 37° F.; at 2 P.M. 50.1° F.; and at 9 P.M. it was 39.5° F.

The line C marks the fluctuations of the mercury in the lower gauge of the black birch, which was at the level of the

ground, and the line B shows the pressure in the upper gauge, which was placed 30.2 feet above the lower one. The remarkable fall, indicated as occurring at 12.45, P.M., was caused by boring into the tree near the ground for the purpose of determining whether the tree was acting simply as a cylinder of water filled by a force from beneath, as seemed evident from the correspondence between the two gauges. The reduction and restoration of pressure from simply opening and closing the orifice were so rapid and extraordinary as to lead to the conclusion that the force operating to produce the pressure was simply the absorbent power of the roots, and this led to the application of a gauge directly to a root, with the surprising result already described,

The drawings for the illustrations were made by Prof. S. T. Maynard.

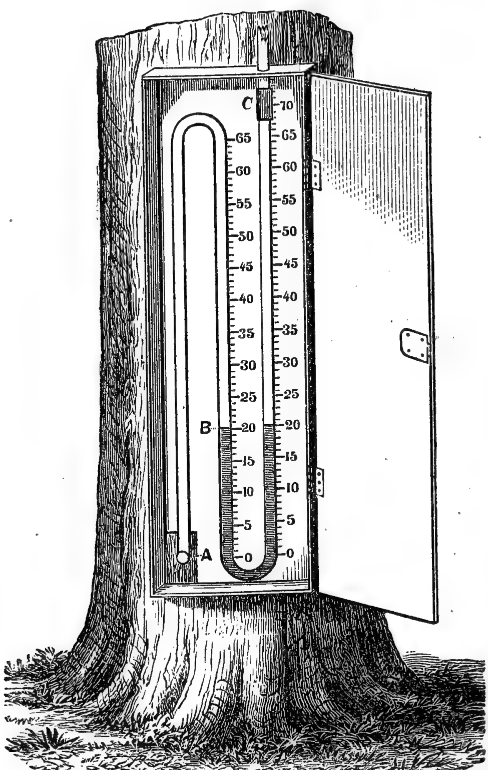
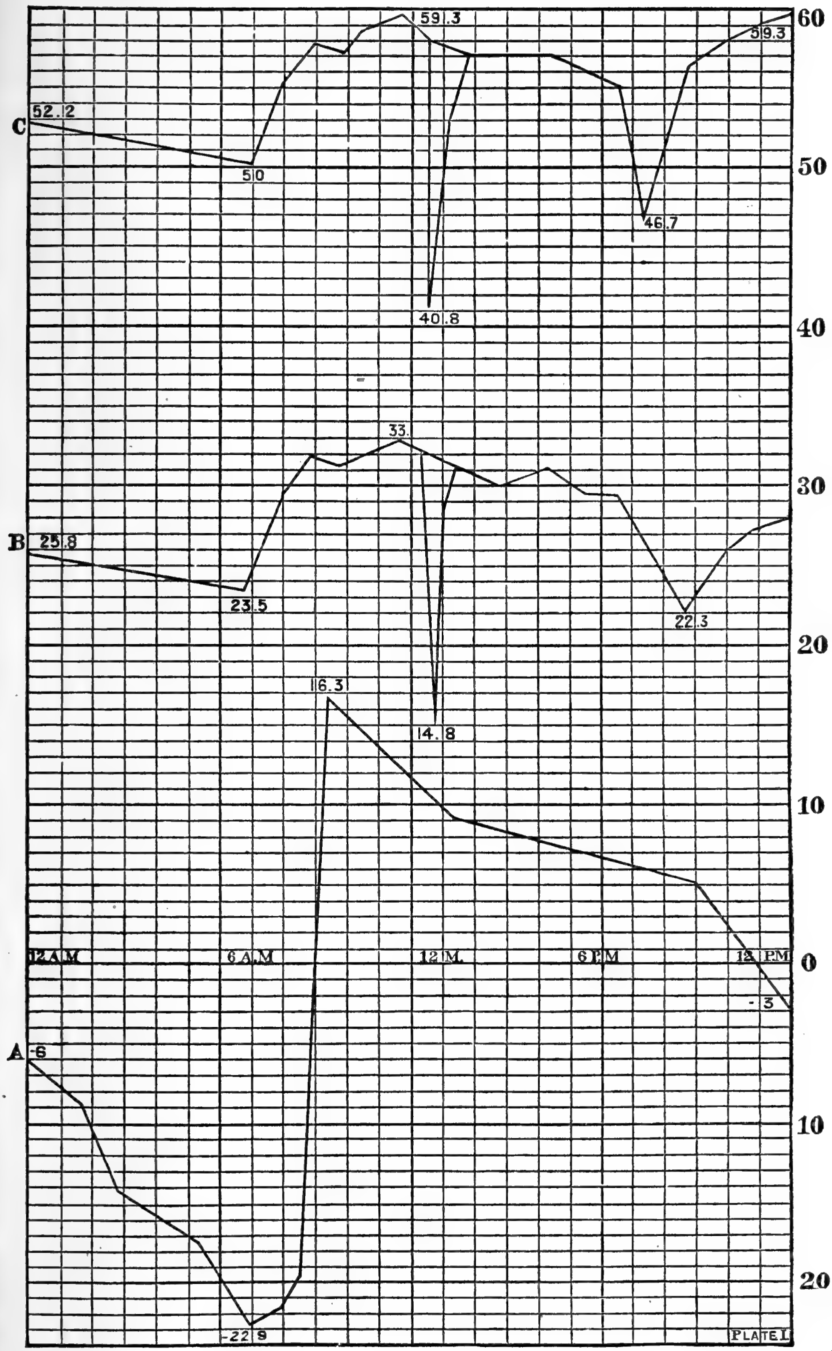


Fig. 1.



C
B
A
52.2
50
59.3
40.8
59.3
46.7
25.8
23.5
33.
14.8
22.3
16.3
-6
-22.9
-3
12 A.M
6 A.M
12 M.
6 P.M
12 P.M
60
50
40
30
20
10
0
10
20
PLATE I.

REPORT

ON

EXPERIMENTS WITH SUGAR-BEETS.

By Prof. C. A. GOESSMANN.

6

REPORT.

In two previous reports* I discussed the rules which guide the European sugar-beet cultivator in his industry; and tried to demonstrate by a series of experiments upon the field and in the laboratory, that the successful introduction of the beet-sugar manufacture depends on the ability of our farmers to produce in an economical way roots fit for that purpose.

In the following pages I present a description of some farther field experiments carried on, partly upon the College farm and partly in the State of New York and the Dominion of Canada. The examinations of the roots raised in these last-named localities were made at the personal request of the Secretaries of the State Agricultural Society of New York and the Department of Agriculture and Public Works of the Province of Quebec.

I.

After having successfully cultivated various kinds of sugar-beets from imported seed, during the years 1870 and 1871, it seemed desirable to study carefully the changes to which the roots of these plants are subject when raised from seed grown upon our own soil. To accomplish this end a few square rods of land, taken from a previous beet-field, were planted on the 15th of May, 1872, with sound roots of the two varieties which had succeeded best with us, the Vilmorin and the Electoral. The plots used for this purpose were three hundred yards apart and the roots placed about two feet from each other. Kainite and superphosphate from bone at the rate of 250 pounds each per acre served as a special manure. The former contained twenty-eight per cent. of potassium sulphate and the latter, from ten to eleven per cent. of soluble phosphoric

* See Eighth and Ninth Annual Reports of the Massachusetts Agricultural College, of the years 1871 and 1872.

acid. The seed, which was collected somewhat later than usual, in the earlier part of September, averaged in the case of the Vilmorin variety about eight-tenths of an ounce, and in the case of the Electoral about one ounce, for each plant. Both kinds of seed were planted during the past season; they yielded under proper treatment roots equal to the best thus far grown in this locality. Their juice contained in some instances as high as 14.3 per cent of cane-sugar.

II.

The seed used in this instance was imported from a reliable dealer in Saxony, and consisted of one package, containing one hundred pounds. From sixty to eighty pounds of it were applied upon the College farm, mainly for the purpose of testing the working of the recently imported German implements for the cultivation of the beet-root. Ten pounds of it were sold to the secretary of the New York State Agricultural Society, who distributed it among some of its officers, with the request to send him at the close of the season a few roots of their crops and to state at the same time the circumstances under which they had been raised. The roots received at the office of the secretary in Albany were immediately forwarded to Amherst and tested by me without delay. The results obtained are stated below in connection with that noticed upon the College farm. I ascribe to these experiments a particular importance for two reasons: first, the roots were raised in every instance from seed taken out of the same package; and secondly, the cultivation of the same seed had been carried on over a quite extensive area. The only circumstance to be regretted regarding the New York experiments consists in the fact that their comparative value is somewhat impaired by the adoption of different modes of preparing the soil for the cultivation of the roots of the sugar-beet. One party at Albion, N. Y., adhered to the rules recommended in my previous reports, the remainder followed their own ideas.

1. *On the College Farm.*—Four acres of a sandy loam, which had been well manured in the spring with stable-manure to raise a good crop of fodder-beets, were planted on the

23d of May, 1872, in part with the above-mentioned seed from Saxony. The crop looked well, considering the dry weather during the month of June. I collected suitable samples of the roots at the close of September and obtained the following results. Six roots, varying from one to two pounds in weight, furnished a juice which measured 11.75° (degrees) of Brix's saccharometer at 50° F., and contained 7.37 per cent. of cane-sugar in solution, according to a test by the polarization apparatus of Dubosq-Soleil.

2. *On a farm at Sing Sing, Westchester County, N. Y.*—The soil upon which the roots were raised consisted of a loam, two feet in depth, which rested upon a layer of a clayish hard-pan, from five to six feet thick. It had served for years for the production of grass. Tomatoes had been the preceding crop. Five hundred pounds of a phosphatic blood-guano per acre were applied before the beet-seed was planted. The roots, fourteen in number, which served for my tests, had been collected during the latter part of October, 1872. They varied in weight from one to four pounds apiece. I selected those weighing from one to two pounds each for my experiments. The juice obtained from them measured 11° by Brix's saccharometer at 39° F., and contained 7.8 per cent. of cane-sugar. A French (Vilmorin) sugar-beet, raised upon the same grounds, produced a juice which measured 12.8° Brix at 58° F., and contained 9.53 per cent. of cane-sugar.

3. *On a farm in the town of Washington, Dutchess County, N. Y.*—The soil consisted here of a clayish loam, and had been ploughed seven inches deep. A liberal amount of rotten sheep-manure was placed in trenches, which were subsequently covered by running two furrows together, thus forming ridges over the trenches. Upon these ridges was planted the seed, May 18th, 1872. The roots were harvested on the 6th of November. I received six of them, which weighed from one to five pounds each; those from one to two pounds in weight only were tested. Their juice contained 10.97 per cent. of cane-sugar, and measured at 50° F., 14° Brix.

4. *On a farm at South Hartford, Washington County, N. Y.*—The soil was a gravelly loam, which had been richly

manured with stable compost, and twice ploughed previous to the planting of the seed. The roots for my tests were collected during the middle of November, 1872; they weighed from one to five pounds apiece. I selected here, also, for the sake of the comparative value of all tests, roots from one to two pounds in weight. The juice secured measured 15° Brix at 56° F., and contained 11.7 per cent. of cane-sugar.

5. *On a farm at Greenwich, Washington County, N. Y.*—The ground used consisted of a sandy loam, underlaid by a fine sand. The seed had been planted upon ridges which covered trenches containing a little rotten stable-manure. The roots were gathered at the close of November, 1872; those sent for examination weighed from one to two and one-half pounds each. The juice measured 12° Brix at 62° F., and contained 9.5 per cent. of cane-sugar.

6. *On a farm at Frankfort, Herkimer County, N. Y.*—No details regarding the mode of cultivation have been received. The roots arrived at Amherst in a frozen condition on the 25th of December, 1872. Their weights varied from one pound six ounces to four pounds and one-half. The juice measured 13° Brix at 54° F., and contained 11 per cent. of cane-sugar.

7. *On a farm at Albion, Orleans County, N. Y.*—The soil used consisted of a dark reddish brown, rich, deep, sandy loam. Clover had been raised upon the land for two years previous to a crop of carrots which preceded the sugar-beets. Twenty loads of horse-manure had been applied to it during the autumn succeeding the crop of carrots. No farther manure was afterwards used, which made the sugar-beet the second crop after the application of stable-manure. The seed was planted on the 8th of May, 1872, in rows twenty inches apart. The roots were harvested, November 13th; six specimens were forwarded for examination. They were of two widely different sizes; three weighed from ten to fourteen pounds, and three, but from one pound and a half to two pounds each. I resolved to test both large and small beets separately, for the purpose of illustrating once more the great difference which exists in the value of small and large roots for manufacturing

purposes. The juice obtained from those above ten pounds (*b*) measured 14° Brix at 62° F., and contained but 9.7 per cent. of cane-sugar. The juice of the smaller specimens (*a*) measured not less than 18° Brix at 62° F., and showed by the test with the polarization apparatus 15.1 per cent. of cane-sugar. Their difference regarding the percentage of cane-sugar proved thus to be 5.6 per cent. in favor of the roots from one to two pounds in weight.

To render the results of these experiments (1–7) more prominent, I state them in a tabular form as follows :—

Locality of the Beet-Field.	Saccharometer oi Brix.	Percentage of Cane-Sugar.	Percentage of foreign substances in solution.
1. College Farm, ...	11.75°	7.37	3.38
2. Sing Sing, N. Y., . . .	11.0°	7.80	3.20
3. Washington, N. Y., . .	14.0°	10.97	3.03
4. South Hartford, N. Y., . .	15.0°	11.70	3.30
5. Greenwich, N. Y., . .	12.0°	9.50	2.50
6. Frankfort, N. Y., . . .	13.5°	11.00	2 50
7. Albion, N. Y. (*a*), . . .	18.0°	15.10	2.90
7. Albion, N. Y. (*b*), . . .	14.0°	9.70	4.30

As the manufacture of sugar from the beet-root does not depend merely on the percentage of sugar, but in a most important degree on the conditions under which it is present, I arrange the above-stated results, also, with reference to the relative proportion of cane-sugar and of foreign substances contained in the juice. The larger the percentage of the latter, the greater, as a general rule, are the expenses of their separation, and thus of the manufacture of the cane-sugar. A good root of the sugar-beet ought to contain in solution not more than from eighteen to twenty parts of foreign substances for every hundred parts of cane-sugar.

	Cane-Sugar.	Foreign Matter.
College Farm,	100 parts.	45.86 parts.
Sing Sing,	100 "	41.02 "
Washington,	100 "	27.62 "
South Hartford,	100 "	28.20 "
Greenwich,	100 "	26.31 "
Frankfort,	100 "	22.72 "
Albion (*a*),	100 "	19.20 "
Albion (*b*),	100 "	45.26 "

Studying these figures with reference to what has previously been said about the requirements of a beet-root fit for an economical manufacture of beet-sugar, we find that in one case only a satisfactory result has been obtained, namely, in the case of the smaller-sized roots at Albion, N. Y. We ask quite properly here, What has caused these unusual variations regarding the saccharine quality of the roots? The seed cannot be the cause, for in one instance, at least, a superior quality of sugar-beet has been raised. The mechanical condition of the soil, judging from the reports received, must have been, in the majority of cases, quite favorable for the object in view; whilst the various kinds of soil turned to account, in most instances, cannot well be considered directly injurious to the growth of a good sugar-beet. There remains scarcely any other explanation of the many failures, than that the modes of manuring the soil have been objectionable. This assumption is fully supported by all more recent observations regarding the influences which control the quality of several special industrial crops, as sugar-beets, tobacco, flax, etc. The application of highly nitrogenous fertilizers, or the incorporation of but partly decayed organic substances, like stable-manure, in the soil during the spring which precedes directly the cultivation of the sugar-beet, are known to re-act injuriously on the composition of the roots; they increase the amount of foreign substances in the juice, prevent a desirable development of the sugar, besides placing the latter under unfavorable circumstances for separation.

Season and soil may, for obvious reasons, somewhat modify the damaging influence of these manures, yet cannot entirely prevent them; for our season of planting is too short and our

climate too moderate in spring to permit a sufficiently rapid disintegration of animal and vegetable matters like stable-manure. The best mode of preparing the soil for experiments like those here under discussion, has been adopted at Albion; it is the same which has been recommended in my previous reports. The sugar-beet was there the second crop, after a heavy manuring with stable-manure. The soil, being a sandy loam, had favored a thorough decomposition of the latter; it contained, in consequence of the slower disintegration of the straw, etc., at the beginning of the second year, largely the constituents of the latter, the potash in particular, ready for assimilation. Potash plants, as a general rule, succeed better during the second year after a manuring with stable-manure than in the first year of its application. The sugar-beet is a potash plant. The beneficial influence of the potash as a special fertilizer on the production of a beet-root of superior saccharine qualities has been repeatedly established by direct experiment.

Believing in the correctness of the conclusions just presented, I planned another series of experiments, with the view of illustrating, if possible, the *peculiar effects* of *various fertilizers* on the *quality* of the *sugar-beet* when *raised* upon the *same piece of land*. The results obtained form the contents of the succeeding chapter.

III.

A piece of land upon the College farm, two hundred and eighty-seven feet long and one hundred and fifty-seven feet wide, running from north to south, and consisting of a brown, sandy loam, which had been well manured with stable-manure during the two seasons previous, was divided into six plots of equal size. These plots ran from east to west across the main field, and from two to three feet of space was left between adjoining lots. Each lot was separately manured, and all the manures were applied at the same time,—about two weeks in advance of the planting of the seeds. The various kinds of sugar-beets were planted in rows, which ran from north to south, passing thus through all the plots treated with different fertilizers.

Plot No. 1 received no fertilizer.

Plot No. 2 received crude potassium sulphate from Stassfurt, Germany, at the rate of three hundred pounds per acre. The potash fertilizer contained fifty-four per cent. of potassium sulphate, or twenty-nine and three-tenths per cent. of potassium oxide.

Plot No. 3 was treated with kainite and superphosphate from bone-meal, at the rate of three hundred pounds each per acre. The former contained twenty-eight per cent. of potassium sulphate (equal to fifteen and two-tenths potassium oxide), and the latter from ten to eleven per cent. of soluble phosphoric acid.

Plot No. 4 was manured with a blood-guano containing potash, at the rate of twelve hundred pounds per acre.

Plot No. 5 received at the rate of twelve hundred pounds of blood-guano per acre, without potash.

Plot No. 6, which represented the most northern portion of the experimental field, was manured on the 7th of May, 1873, with fresh horse-manure, at the rate of fourteen tons per acre.

Four kinds of seed were planted on the 16th of May, 1873. They consisted of the two sorts, Vilmorin and Electoral, raised during the previous year upon the College farm (see page 43) ; a white sugar-beet received from Freeport, Illinois, and Sutton's improved English sugar-beet, obtained from Hon. T. L. Harrison, of Albany, N. Y. The early planting secured the success of the experiment, as far as a healthy growth was concerned.

The crop looked well from the beginning to the end of the season. I began the examination of the roots on the 6th of October, 1873, and carried it on for two successive weeks. The roots selected for testing were of a corresponding size, and their weight varied from twelve ounces to two pounds each. As these experiments were made mainly for the purpose of studying the influence of fertilizers on the development of cane-sugar within the roots of the sugar-beet, I state only the percentage of this substance, found in the roots raised from the different varieties of seed with the several fertilizers.

KIND OF FERTILIZER.	PERCENTAGE OF CANE-SUGAR FOUND IN JUICE OF ROOTS RAISED FROM THE FOLLOWING SEEDS.			
	Freeport, Illinois.	Sutton's, English.	Electoral, College Farm.	Vilmorin, College Farm.
Fresh horse-manure, . . .	11.96	9.71	9.42	7.80
Blood-guano without potash, . .	10.99	9.17	10.10	10.20
Blood-guano with potash, . .	12.55	10.01	13.24	10.50
Kainite and superphopshate, . .	13.15	10.91	12.16	10.50
Sulphate of potassa, . . .	14.52	12.42	14.32	12.78
No manure: second year after stable-manure, ...	13.49	–	12.78	12.19

These results have been in some instances repeatedly confirmed. They scarcely need, after what has been said previously, any farther interpretation. The influence of fresh stable-manure in the first year is too striking to be passed over without recognizing its decidedly injurious character. Even a light, sandy loam cannot entirely destroy its peculiar re-action on the composition of the roots. These experiments apparently confirm my assumption regarding the many failures noticed in the trials of the previous year (see chapter II. of this paper).

IV.

The Secretary of the Department of Agriculture and Public Works, at Montreal, Canada, has for several years past directed his special attention to the cultivation of the sugar-beet throughout the Province of Quebec. Seeds have been distributed of late, at his suggestion, by the Government of Canada, and the results thus far obtained are considered in official circles highly encouraging. I have tested during the past two years, at the request of the authorities at Montreal, various specimens of roots raised in that locality. As the results obtained refer to sugar-beets raised in a more northern region than thus far reported on, I take the liberty to enter them here on record, on account of the general interest they may claim.

The first lot of beet-roots sent on from Montreal, arrived, November 11th, 1872. They consisted of three samples of roots, varying in weight from one pound and a half to six pounds

and a half apiece. Two kinds proved to belong to the quality of fodder-beets; they contained from four and three-tenths to five and eight-tenths per cent. of cane-sugar. The third sample consisted of three roots, which resembled in form a large Electoral; they weighed from four pounds to six pounds and a half apiece. The juice of these roots measured 13° Brix at 54° F., and contained 9.70 per cent. of cane-sugar. Considering the unusual size of the roots, the result was encouraging. The second lot of sugar-beets arrived, October 24th, 1873,—consisting of four samples from four different localities. They were tested without delay, and gave the following results.

1. *Echaullon de Montreal.* Two roots, one foot long and two and a half inches thick, weighed, respectively, two pounds and one ounce and two pounds and eight ounces. They produced a juice which measured 15.4° Brix at 64° F., and contained 11.38 per cent. of cane-sugar.

2. *Riviere du Loup.* Three well-shaped, compact roots weighed from two pounds to three pounds and four ounces each. Their juice measured 14.5° Brix at 63° F., and contained 10.20 per cent. of cane-sugar.

3. *Chambly.* Three roots, compact, abruptly terminating and then branching out, weighed from two pounds to two pounds eight ounces apiece. The juice obtained from them measured 13.2° Brix at 63° F., and contained 9.02 per cent. of cane-sugar.

4. *Maskinonge.* Three roots, well shaped and healthy, weighed from two to three pounds. The juice obtained from them measured at 63° F., 13.4° Brix, and contained 8.83 per cent. of cane-sugar.

In comparing the results obtained in Canada with those noticed in the State of New York, we find but little difference as far as the majority of cases is concerned. A stricter compliance with well indorsed rules of cultivation will, no doubt, produce a higher and thus a satisfactory quality of sugar-beets in both localities. The fact that they may be planted during the middle of May and still reach a condition of ripeness at the close of September, favors their cultivation in the more northern sections of this continent.

As the experiments described in the previous pages termi-

nate a series of inquiries carried on upon the College farm for the purpose of illustrating by practical operations the proper mode of cultivating a good sugar-beet, and of studying at the same time the extent of our resources for the beet-sugar manufacture, it seems but proper, before closing my discussion of these questions, to state in a few words the value which I ascribe to field experiments, similar to those just finished. The very nature of the influences which govern the growth of plants and contribute thus to the financial success of any agricultural industry, renders it quite obvious that the results even of the most carefully conducted field experiments are, in a certain sense, frequently of a mere local value. Rules of cultivation, derived from experiments carried on upon a limited area, ought to serve for this reason only as a base for corresponding trials in other localities. Their claim for a more general consideration increases in the same degree as they are found to be applicable with success over a larger area. The system of cultivating a sugar-beet fit for the economical manufacture of sugar, which has been recommended in my previous reports, is indorsed by many leading agriculturists in Europe, and has been fully confirmed by series of experiments upon the College farm and elsewhere within the northern portion of this continent. It is on these grounds that I desire a careful study of my communications regarding the best mode of raising a valuable sugar-beet for the manufacture of beet-sugar. The successful solution of this problem is worthy the attention of all friends of a closer union between the agricultural and manufacturing interests of the country.

REPORT OF JOHN C. DILLON,

FARM SUPERINTENDENT.

REPORT.

President W. S. Clark.

Sir:—I have the honor to submit my annual report of farm operations for the year 1873.

During the months of January, February and March, the men and teams were occupied in felling, trimming and getting to the mill chestnut and pine timber for making trellis-posts for the vineyard, post and board fences, and for repairs.

Oats and Grass-Seed.

The land which was planted with field and fodder corn, sugar-beets and ruta-bagas last year, was ploughed, harrowed and sown with oats and grass-seed, between the 21st of April and the 10th of May. Four acres of this, being of a very dry, gravelly character, suffered severely from the drought. Of the remainder, five acres yielded a fair crop of fodder, which was secured in perfect condition; and three acres, where beets were raised last year, yielded ninety-six bushels of very handsome oats. All the oat-crops were materially diminished by the severe and protracted drought.

Potatoes.

The potatoes were raised on land from which a crop of rye was taken last year. A dressing of stable-manure, six cords to the acre, was spread and ploughed in five inches deep, the piece was marked out with the beet-planter into rows three feet apart, furrowed, planted the 13th of May, with halves of potatoes 18 inches apart, covered with Thomas' smoothing-harrow, and the whole of the after-cultivation performed by the smoothing-harrow and double mould-board plough, as described in previous reports. The season was unfavorable to a large yield, and the crop was somewhat injured by the wire

worms. Still, the yield was a very satisfactory one, amounting to three hundred and twenty-five bushels of marketable potatoes, eighty-seven bushels of planting size, and thirty bushels of small ones. The kinds planted for the main crop were Early Rose, Peerless and Brigham Seedlings. A few of the Orono, King of the Earlies, Campbell's Late Rose and Brezee's Prolific were planted for experiment, and gave interesting and satisfactory results; which, however, cannot be fairly stated without lentghy and tedious explanation. Besides the main crop, one hundred and twenty-five bushels of potatoes were raised on headlands, and on about half an acre reclaimed from the ravine. The quality of all the potatoes was excellent.

Sugar-Beets, Millet and Sweet-Corn.

None of the land planted with corn last year being suitable for beet-culture, we carted and spread manure last fall on an acre and a half of land, from which potatoes had been harvested, at the rate of ten cords to the acre, and ploughed it in six inches. In the spring, ploughed again eight inches deep, and on the 14th of May harrowed with Nishwitz, and afterwards crossed with Thomas' harrow; and planted beets, using twelve pounds of seed to the acre. Owing probably to the excessive drought, the seed germinated very unevenly, and it soon became evident that it would be impossible to obtain a fair crop. We therefore ploughed them in, June 12th, and the next day sowed the land with millet. This produced nearly four tons of dried fodder; and being cut early, and secured in fine condition, it is about equal to the best hay.

An acre of land, where beets were raised last year and corn the preceding year, was prepared under Dr. Goessmann's direction for his experiments in beet-culture, which I presume will be detailed in his report. As Dr. Goessmann only used about a fourth of this acre, the remainder was planted by the beet-planter with sweet-corn, cultivated almost entirely by the beet-machinery, and yielded one hundred and ten bushels of ears, and two tons of fodder. I regard this as a very valuable crop; poultry prefer the grain to any other feed; our cattle like the stover much better than that of ordinary field-

corn, and, from the fact that there is a demand fer the seed at two dollars per bushel, I infer they are not singular in their preference.

Corn.

The corn was planted on land from a part of which a crop of potatoes, and from the rest a crop of rye, both without manure, were taken last year. Eight cords of stable-manure, mixed with compost from the vaults, were applied per acre, and ploughed in five inches deep, from the 5th to the 13th of May. The corn was planted in rows eighteen inches apart, with the German planter, from the 15th to the 20th of May, except about one acre reserved for Prof. Stockbridge's experiments, and planted under his direction, in hills, on the 22d of May.

Owing to the excessive drought, about an acre and a half failed to come up satisfactorily, and we ploughed it in, and planted an acre with sweet-corn for fodder, and half an acre with Swedish turnips, both of which yielded very large crops.

The remainder of the corn, five acres and a quarter, was carefully cultivated, mostly by horse-power, and made an excellent growth, yielding in the whole seven hundred and fifty bushels of sound ears, and six barrels of pig corn.

Hay.

The grass-crop was fully one-third below the average, owing to the early and continued drought; the quality, however, was excellent, and it was secured easily, cheaply and in the finest possible condition. At the time of harvesting the oats and millet, it was feared that the seeding with grass had in many places entirely failed; I am glad to report that since the fall rains, the prospect of a grass-crop, on newly seeded lands, has greatly improved.

Small Fruits.

The strawberries promised well in the early part of the season, but were so parched that they only yielded a few boxes. The raspberries and currants bore abundantly, though the size of the berries was much diminished by the dry weather.

The blackberries (Kittatinny) were winter-killed nearly to the ground; and considering their tenderness, and the great difficulty in keeping them in bounds, owing to their rank growth and tendency to sucker, I am not encouraged to advise their extended culture.

Garden Vegetables and Swedes.

Manure, at the rate of ten cords to the acre, was spread on the vegetable-garden and ploughed in, and a great variety of garden vegetables was planted and cultivated by the students, under the direction of Prof. Stockbridge. Most of these crops were prosperous and productive; but 137 rods of onions, at the south end, failed to come up satisfactorily, and I was instructed to plough them in, and plant some other crop.

I accordingly ploughed the land eight inches deep, harrowed, marked with the beet-planter in rows 18 inches apart, planted, the 13th of June with Swedish turnips (chiefly Carter's improved purple-top), using two pounds of seed to the acre, and harvested, November 6th to 11th, thirty-two tons six hundred and seventy-eight pounds, or at the rate of a trifle more than thirty-eight tons to the acre.

Reclaiming and Improving Land.

Soon after haying, we ploughed about twelve acres of land lying east of the brook and intersected by the county road, and have since sown it with rye. This land is rough, cold, springy, weedy and barren, and has never yielded crops worth harvesting. At the same time, I know of no land that will better repay the cost of improvement, and it is proposed to drain, grade and cultivate it, as and when means and opportunity permit.

About four acres of stony and uneven land, near the nursery, have been heretofore used as a sheep-pasture. It was unsuited to this use for two reasons: first, because there is no water in it; and secondly, because it is so secluded, that a small flock might be destroyed by dogs, without any one seeing the slaughter. It was therefore determined to bring it into condition for mowing, and with this view it has been ploughed and summer-fallowed, a hundred and two loads of

stone picked off, and the land sown with rye. After harvesting the rye, and another crop of stones, it is proposed to top-dress, and seed down with grass-seed.

During fine weather in the summer, the cows are kept in the yard nights, and, in the winter, are turned out into the yard to drink, and remain out a longer or shorter time, according to the weather. This yard is well supplied with loam, sand and muck, and is also the receptacle for refuse matter generally. It is ploughed frequently in summer, and furnishes, yearly, a large amount of excellent top-dressing. This fall, we carted out four hundred and fifty loads, which we spread on twenty-two acres; and we have carted into the yard, two hundred loads of materials, for next year's supply. The vaults have also been kept well supplied with absorbents, and have added materially to the manurial resources of the farm.

The Horticultural Department.

The nursery, the young orchards and the vineyard have also been supplied with manure, and kept thoroughly cultivated, but do not, at present, yield any considerable pecuniary return.

List of Crops cultivated on the College Farm during the year 1873.

Crops.	Area.*	Yield.
Oats (N. E. lot), ...	5.0.47	$7\frac{1}{4}$ tons stover.
" (near Prof. Stockbridge's,)	3.0.00	$1\frac{1}{2}$ " "
" (north of barn), . .	1.0.00	$\frac{1}{4}$ " "
" (near boarding-house), .	3.0.00	96 bushels oats, 2 tons straw.
Potatoes (main crop), . . .	2.0.23	442 bushels.
" (reclaimed land, &c.),	3.00	110 bushels.
Field-corn, ...	5.0.36	750 bushels sound, 6 barrels pig.
Sugar-beets, ...	1.00	several loads.
Sweet-corn, ...	3.00	110 bu. ears, about 2 tons fodder.
Turnips, ...	1.3.00	52 tons.
Millet, ...	1.1.03	$3\frac{3}{4}$ tons.
Fodder-corn (near barn), .	1.0.00	valuable soiling.
" (N. W. lot), .	3.0.34	$3\frac{3}{4}$ tons dried fodder.
Small fruits, ...	1.1.08	270 boxes.
Nursery, ...	1.3.00	
Vegetable-garden, . . .	1.3.11	a variety of vegetables.
Young orchard, ...	3.0.00	
Vineyard, ...	2.0.00	
Carried forward, . .	36.2.02	

* The area is given in acres, roods and rods.

Crops.	Area.	Yield.
Brought forward,	36.2.02	
Arboretum,	3.0.00	
Ploughed and sown with rye,	16.0.00	
Total area in tillage,	55.2.02	
" " mowing,	121.1.07	135 tons hay.
" " pastures,	126.1.07	
" " woods & roads,	80.1.24	
	383.2.00	

Extra Work.

Whenever they could be spared from the regular farm-work, the teams have been employed in filling up the old lane or gully between the brook and the plant-house, in making causeways to the new bridge across the brook, in grading for and making new roads from the College to the botanical museum and thence to the President's house, in making, altering and repairing bridges and culverts, in clearing up old hedge-banks, in getting to mill and delivering 39,000 feet of timber, in aiding the students in setting out trees, in hauling baggage, coal, chemicals, cannon, stone, sand, bricks, mortar and loam, in obtaining and afterwards disposing of subjects for veterinary study and practice, in constructing walks, grading and preparing the site of the Massachusetts garden, in ploughing and sub-soiling two acres for the proposed pinetum, and in other work ordered by the proper authorities, and necessary and expedient to the welfare, progress and prosperity of the several departments of the College.

Buildings.

The barn and sheds at the south end of the estate are ample and convenient for the uses for which they are designed.

After drawing out the manure in spring, we cover the cellar bottom with loam, and increase the depth of this covering, from time to time, during the summer and fall. We also provide a supply of sand for bedding the stock in winter. This has hitherto been stored in one of the sheds; but, inasmuch as the wheeling it to the barn, in stormy and icy weather, is difficult and inconvenient, it is proposed to convert the

calf-pen, at the east end of the barn, wholly or in part, into a storage-room for absorbents, which can be readily dumped into it, through a scuttle in the barn floor.

We have torn down the dilapidated old wagon-sheds at the north barns, and moved a comparatively new shed, formerly used as a laundry, into their place. This, with a little fixing, furnishes a convenient shelter for the wagons, a handy tool-room, and adds very much to the utility and appearance of the premises.

Stock.

The stock has been generally thrifty, prosperous and productive, and its reputation has been enhanced by numerous premiums at the New England and other shows, amounting to two hundred and two dollars in money, besides medals and diplomas.

Shorthorns.

The Shorthorns comprise one bull and thirteen females. The bull "Belvidere" (11,364), is an excellent representative of this aristocratic race. His pedigree is annexed. "Belvidere" (11,364), bred by Charles Parsons, Jr., Conway, Massachusetts; owned by Massachusetts Agricultural College, Amherst, Massachusetts. "Roan," calved September 20th, 1870; got by "Falconwood" (6,732), out of "Lady Princess," of Conway, by "Sheridan" (6,179). "Fairy Bell," by "Highflyer" (578). "Tube Rose 7th," by "Tornado" (1,041). Imp. "Tube Rose 3d," by imp. "3d Duke of Cambridge," (5,941). "Tube Rose 2d," by "Earl of Antrim" (10,174). "Tube Rose," by "South Durham" (5,281). "Rose Ann," by "Bellerophon" (3,119). "Rosette," by "Belvidere" (1,706). "Red Rose," by "Waterloo" (2,816). "Moss Rose," by "Baron" (58). "Angelina," by "Phenomenon" (491). "Anne Boleyn," by "Favorite" (252). "Princess," by "Favorite" (252). "Bright Eyes," by "Favorite" (252). "Bright Eyes," by "Hubback" (319). "Bright Eyes," by Snowdon's bull (612). "Beauty," by Masterman's bull (422). "Duchess of Athol," by Harrison's bull (292). "Tripes," by the Studley bull (626). Bred by Mr. Stephenson, Ketton (1,739).

"Falconwood" (6,732), got by "2d Earl of Carlisle"

(2,804), out of "Lady Sale 5th," by "Red Knight (890), &c. (Pure Princess.)

"Sheridan" (6,179), got by "6th Duke of Thorndale" (4,752), out of "Bertha," by "Duke of Thorndale" (2,787). "Gloster's Bloom," by imp. "Duke of Gloster" (2,763), (11,382), &c., &c.

"Highflyer" (578), got by "Duke of Gloster" (11,382), dam, imp. "Diana Gwynne," by "Duke of Lancaster" (10,929), &c., &c.

This pedigree shows an admirable mixture of the Duchess and Princess blood, without any outcross, except that of "Bloom," by "Sir Leonard" (10,827), through "Sheridan," (6,179).

That this is no ignoble alliance, may be gathered from the fact that "Brenda" and "Berlinda," one a year and the other two years old, nieces of "Sheridan," were sold at Mr. Campbell's sale, for $2,300 and $2,500; whilst, at the same sale, "Belvidere's" cousins, the Princesses and Duchesses, commanded from $1,000 to $30,600.

In individual merit, "Belvidere" is worthy of his illustrious ancestry. He is a rich light roan, of perfect symmetry, admirable quality, and remarkable vigor, united with great docility and kindness of temper; and, as he is descended from a long line of eminent milkers, his services as a stock animal are almost invaluable.

He has taken several first premiums, including first as a yearling at the New England show in 1872, and first at the Hampshire, Franklin and Hampden, in 1873; and, though three out of the five judges at Medford, this year, concurred in placing him second in the two-year-old class, the other two have published in the "Country Gentleman," their conviction that he was "head and shoulders the best bull on the ground."

The cows are mainly handsome, thrifty animals, tracing their lineage through the famous herds of Augustus Whitman, Paoli Lathrop, S. W. Buffum, George Vail and Samuel Thorne, in America, and Wetherell of Kirkby Mallory, Whitaker of Greenholme, and Bates of Kirkleavington in England, to the even more celebrated animals, bred and owned by the brothers Colling, and their contemporaries

and predecessors, as far back as the middle of the 18th century.

Being all deep, rich milkers, they fully sustain our cherished conviction, that cows give milk as horses trot, in all shapes; and that under favorable conditions, it is not only possible, but reasonable and desirable, to unite an eminent capacity for the profitable production of milk and butter, with the most admirable symmetry and an unsurpassed tendency to take on flesh when dry.

While we admire the concentrated power which enables the high-bred Shorthorn of the present day to perpetuate, and also to stamp upon other races of cattle, his distinguishing excellence, we cannot shut our eyes to the evils which have resulted from the practice of indiscriminate in-and-in breeding, and still more from the temptation, which the system offers to unprincipled persons, to raise and sell animals radically defective in quality or constitution, and thus to fix and intensify faults instead of desirable properties.

Believing that no pedigree, either in man or beast, can atone for the want of individual merit; and also, that whatever is not good enough to keep, is not good enough to sell for breeding purposes, the managers of the College farm have yearly slaughtered several thoroughbred animals, and this course should be persevered in until every breeding animal on the farm is eminent both for the possession of and the power to transmit a high degree of excellence, untarnished by patent or latent unsoundness or defect.

Ayrshires.

The Ayrshires comprise one bull and thirteen females.

The bull, "Lord Ronald," is a very perfect animal, and has received first premium at several shows, including the New England at Lowell, 1872, where his sire, "Colfax" (127), was also awarded 1st premium in the aged class, and sweepstakes medal, as the best Ayrshire bull of any age.

As the fountain from which many of the College Ayrshires derive their descent, and also as a remarkable example of vigor, fertility and usefulness, "Old Beauty" deserves more than a passing notice. She was calved in Scotland, in the spring of 1854, and has therefore, nearly completed her

twentieth year. She was imported in 1855, by Mr. W. Watson, of Westchester, New York, and sold by him to Luke Sweetser, Esq., of Amherst, who kept her till 1870, and then sold her to Mr. Watson, of this town, of whom we purchased her in 1871. She has repeatedly given 45 lbs. of milk a day; and, on pasture alone, has given her live weight of milk in 20 days, an average of 42 lbs. daily. On the 1st of January, 1872, she dropped the heifer-calf "Beauty 11th," and, the 5th of February following, she gave 38 lbs. of milk, yielding 12 per cent. of cream. The 10th of April, 1873, she dropped a bull-calf, by "Colfax" (127), and is now with calf by "Lord Ronald," and giving eight quarts of milk a day. Her great, great, great, grand-daughter, "Beauty 12th," a very promising animal, has the following pedigree:—

"Beauty 12th," bred and owned by Massachusetts Agricultural College, Amherst, Massachusetts, red and white; calved 14th of January, 1873; got by "Colfax" (127).

Dam "Beauty" (870), got by "Comet" (130). Dam "Rosa" (1,780), got by "Zero" (401). Dam "Susa" (781), got by "Archie" (85). Dam "Bell" (251), got by "Oswald" (51). Dam "Beauty 8th," calved in 1854, imported in 1855, still breeding regularly, and giving now, January 1st, 1874, eight months after calving, eight quarts of milk daily.

Ten bulls and thirty-three cows of "Old Beauty's" descendants were recorded in the "Ayrshire Herd-book," up to July, 1871; many thoroughbreds, besides an innumerable host of grades, have never been recorded, and many scores have been bred since the last volume was issued; her extraordinary strength of constitution and fixity of type are evidenced by the singular fidelity with which her form, color and milking properties are reproduced in her descendants; and her influence on the milking-stock of the country must have been very great. Her descendants in the College herd trace their pedigree, through bulls of repute, from the celebrated herds of Messrs. Peters, Stone, Pond, Birnie, Lyman and Hungerford & Brodie, and possess in a high degree the beauty, constitution and milking qualities, for which these families of Ayrshires are eminent.

Besides the "Beauty" family, the College have other animals, from the importations of Messrs. William Watson and A. B. Conger, of New York, and James Logan, of Montreal; all with perfect pedigree, and fine quality.

The bull "Colfax" (127) was universally recognized as a model animal of the breed; and, with the approbation of the executive committee, he was carefully slaughtered, May 6th, 1873, and his hide and skeleton preserved for the College museum. His live weight was 1,655 lbs., and he was estimated to be worth for beef eighty dollars. His flesh and tallow realized sixty-six dollars, so that his hide and skeleton cost fourteen dollars; not an exorbitant price for such valuable specimens.

Jerseys.

The Jerseys consist of one bull and three females. The bull "Grand Duke" (408) is a very beautiful animal, bred and presented to the College by O. B. Hadwen, Esq., of Worcester, Massachusetts. He is by "Wellington" (279), out of imported "Buttercup" (239). "Wellington's" pedigree is thus recorded in the "American Jersey Herdbook," volume III., page 13.

"Wellington" (279), fawn and white; dropped May 1st, 1869; owned by O. B. Hadwen, Worcester, Massachusetts; bred by George Frost, West Newton, Massachusetts. Sire "Master William" (152), imported by George Frost in 1868, and sold to Alvin Adams for $600. Dam "Jersey Queen" (395), imported by George Frost, West Newton, Massachusetts, in March, 1868, and sold to C. S. Sharpless of Philadelphia, for $650.

The heifers, one, two and three years old, are all the produce of the cow "Rose" (1,212), by bulls from the herds of Charles G. Loring, E. G. Bowditch and James Thompson, and for their age are very promising.

Brittanies.

These consist of a bull, "Merlin," bred on the College farm, and a cow, "Pauline," bred by Mr. Flint, and presented by Mr. Knowlton, of Upton, and are excellent specimens of this beautiful little breed. On account of their diminutiveness, they are not likely to become popular among the farmers of the

Connecticut Valley; but, as dairy-cows for short pastures, or as family cows for suburban residents, they have peculiar qualifications.

The Dutch or Holsteins

are represented by a bull, "Fourth Highland Chief" (14), bred and presented by Winthrop W. Chenery, Esq., of Belmont, Massachusetts; and a heifer calf, "Midwould 19th," also bred by Mr. Chenery, and purchased for the College last summer.

The properties claimed for these cattle are large size, admirable symmetry, an extraordinary capacity for milk, and a proportionate aptitude to fatten kindly when dry. As far as I have had opportunities of judging, these claims are well sustained.

"Fourth Highland Chief" is now two years and seven months old, and weighs 1,875 lbs., in fair working order. During the past year, he has been in the yoke nearly every day, and has shown unusual strength, quickness and docility. His calves from grade cows are eagerly sought after for veal, for steers and for raising for cows.

The heifer "Midwould 19th," dropped March 14th, 1873, is a very promising animal. She has had good food and care, but no forcing, and weighed, December 1st, 580 lbs.

The Devons and Swiss.

In my report of last year I referred to the case of "Gem 3d" (502), a valuable Devon cow, who was slaughtered after a lingering illness; and whose viscera were found to be loaded with tuberculous deposit. Her daughter "Enid" (934½), and her son "Arthur," have since given evidence of being affected, and have therefore been slaughtered, and portions of their organs showing the insidious character of the disease, have been preserved for the use of the professor and students of veterinary science.

This reduced the Devons to three, viz.: the seven-year-old bull "General Lyon" (232), and the cow "Pixie" (1,199), and her heifer calf "Peri." These were in no way related to "Gem," were perfectly healthy, and excellent specimens of the breed; but, by a vote of the executive committee, I was

directed to dispose of the remaining Devons and the Swiss, and I accordingly sold the Devon cow and calf to Mr. E. O'Rourke of New Brighton, Pennsylvania, and had the Swiss and Devon bulls slaughtered.

The keeping of many breeds of animals adds materially to the expenses of the farm, as well as to the anxiety and care of the superintendent; at the same time, the opportunity of comparing and contrasting the merits and defects of the various breeds was so evidently esteemed, both by students and visitors, that it seems undesirable to dispense with a breed of fixed character and recognized value, except as a measure of necessary economy.

Swine.

The College has now thirty-three swine, comprising representatives of three different breeds.

The Chester Whites

were obtained of the late Dr. Calvin Cutter, of Warren, a breeder of acknowledged skill and character, and for change of blood recourse has been had to the pens of Charles Parsons, of Conway, Mass., and Nicholas Guilbert, of Gwynedd, Penn.

The Chester Whites possess good forms, contented dispositions, hearty appetites, vigorous digestions, robust constitutions, extraordinary prolificacy and the temper and ability to bring up the largest litters handsomely.

They will fatten as early as any other breed, or, if kept to maturity, they will attain to a very large size, and we can scarcely conceive of any more profitable or generally satisfactory breed for the farmers of this section.

The boar Marmion, referred to in my last report, was slaughtered March 11th, 1873, being then two years and eleven months old. He weighed alive 1,020 pounds, and yielded 500 pounds of lard and 180 pounds of lean meat. He was perfectly active and healthy, and, a few days before he was killed, walked cheerfully some fifty rods to be photographed by Mr. Lovell. An excellent portrait was obtained, which, together with his hide and skeleton, will furnish an interesting and valuable addition to the College museum of veterinary science.

The Berkshires

are from the pens of Messrs. Hartshorn & Sons, of Boston, Tyler, of West Haven, and Chase, of Florence, and are excellent specimens of this very valuable breed. They do not grow to the size of the Chester Whites, but are somewhat firmer in bone, and, having been cultivated as a separate breed for a longer period, their distinctive properties are more marked and fixed. Their hair is fine and their ground-color black. The fashionable markings are four white feet, white throats, white tip of tail and white stripe in the face. It is claimed, and we think with justice, that the Berkshires give a greater proportion of lean to fat than any other breed.

The Essex

are from the pens of Mr. Fairlee, of New Jersey, and Mr. Chase, of Florence. They are black, almost destitute of hair, very fine boned, quick to mature, and furnish an excellent quality of meat, with a very small proportion of offal.

Sheep.

In my last report, I referred to our need of a flock of sheep, and my hesitation to purchase suitable animals on account of the danger to which they would be subject from dogs, and I regret to say that this risk has in no way been lessened.

Nevertheless, the necessity of a flock to illustrate this important branch of farm economy was so apparent, and the lack of it so evidently a surprise and disappointment to the farmers who visited the College that, with the approbation of the President, I have purchased five fine Cotswold ewes from the imported flocks of Messrs. D. F. Appleton, of Ipswich, Mass., and R. W. Cameron, of Clifton, Staten Island, N. Y., and the latter gentleman has presented to the College a Cotswold buck of extraordinary size and quality.

Poultry.

The poultry-houses are well supplied with first-rate specimens of Games, the nearest thoroughbred representatives of the original fowl. The Houdans and Gold-spangled Polands

represent the crested, non-sitting breeds; and the White and Partridge Cochins, the large Asiatics.

The Games.

For elegance of form, beauty of plumage, hardihood, courage and gallantry the Game-cock is unrivalled. The hen is a good layer, a good but not inveterate sitter, and a brave, careful and industrious mother. In this latter capacity she is often employed by the breeders of large fowls for exhibition. As table-poultry the Games are inferior to none, either as regards the flavor of their flesh or the proportion of meat to the bone. The Black-breasted Red and Duckwing Gray are the most gorgeous in color, and have the most clearly defined markings, and they are unsurpassed for elegance and courage.

The Houdans and Golden Polands.

These are very beautiful varieties of fowl. They seldom manifest a disposition to sit till they are three years old, but devote their energies to the production of eggs with a perseverance which has earned for them the title of everlasting layers. The Houdans are crested and bearded, color black, splashed or mottled with white. The Gold-spangled Polands have large crests but no beards; their color is a rich yellow ground, each feather ending with a large black half-moon or spangle.

The Cochins.

These are fine large fowls, often attaining the weight of twenty to twenty-five pounds the pair. In our experience, the production of eggs in winter depends less on the breed selected than on the conditions under which fowls are kept. Still, the fact that the ancestors of the so-called Asiatics were accustomed, at no distant day, to enjoy their midsummer in December is not without its weight in seconding the efforts of the poultry-keeper, and certainly the Brahmas and Cochins have an enviable reputation as winter layers. Their other valuable properties are rapid growth, large size, peaceable dispositions, hardiness, the ability to bear confinement and excellence as sitters and mothers.

Pigeons.

In the pigeon-loft are fine specimens of ten distinct breeds, besides as many sub-varieties. The beautiful Fantails, with swan-like carriage; the Pouters, whose peculiarity consists mainly in the size to which they can inflate their crops; the Carriers, with their flat heads and long, strong beaks, and the Tumblers, with head and beak aptly likened to an oat stuck in a cherry; the Jacobins, with colored body and cowl and white head and tail, and the Nuns with white bodies and hoods and colored heads and tails; the Turbets, with white breasts, and the Archangels with copper-colored ones; the trumpeters, with their singular musical coo, resembling the pouring of water from a bottle, and the beautiful starling Quakers, with their spangled breasts and white wing-bars instead of black, as in the *Columba livia* and most of its varieties. Their striking modifications of form, color, arrangement of feathers, action and voice admirably illustrate the plasticity of species, on which Darwin bases his ingenious hypothesis; though a more careful study shows the far higher wisdom of the lamented Agassiz, confirms our belief in an omniscient and omnipresent Creator, and saves us the humiliating necessity of confessing our descent from the monad *via* the ape.

The fowls and pigeons have been healthy and, considering the unavoidable lack of privacy to which they have been subject, productive and profitable. They have been entered at several exhibitions, including the Massachusetts and the New England Agricultural, and have received their full share of first and other premiums. They have also been objects of much interest to students and visitors, and besides serving to illustrate and corroborate settled doctrines with regard to animal physiology they have suggested ideas which, if confirmed by further experience, will be of great practical value to the farmer and stock-breeder.

Additional accommodations for keeping, breeding and experimenting have been supplied, so that the inconveniences alluded to are in a great measure remedied, and it is hoped that next year the poultry will make a still more ample return in money and instruction for the capital, labor and thought expended on them.

The Bronze Turkeys

have bred and thriven satisfactorily, and, besides adding to the attractions of the farm, have made a good return for their feed and care.

The Rouen Ducks

have been prolific in eggs, but, for want of suitable accommodations, have failed to raise their young. With better provisions we hope for greater success next year.

The Teams

consist of six excellent farm-horses and five bulls. The practice of using the bulls in the place of oxen has continued to work satisfactorily, and it is now proposed to try the experiment of using them single in the farm-wagon and tip-cart.

Horse-Breeding.

In my last report, I alluded to the expediency of the College owning a good stallion. After consultation with the president and such of the trustees as were specially interested in horse-raising, I made arrangements with Mr. Chenery, of Belmont, for the loan, with the option of purchase, of a Thoroughbred stallion colt of good size, fine figure, perfect temper and admirable trotting action, all of which properties he inherited from a long line of illustrious ancestry. Unfortunately his price was considered higher than, under present circumstances, the College could afford to pay, and he was returned to Mr. Chenery. None the less do I hear the question from visitors, "Where's your stock-horse?"

Students.

Keeping constantly in mind that one of the chief uses of the farm is to interest and instruct the students in the science and practice of agriculture, I have diligently striven to enlist the sympathy and, as far as practicable, the assistance of these gentlemen in the various operations of the farm. I have been exceedingly gratified and encouraged to believe that my efforts have been appreciated. While the barn has been a favorite resort for the students in their leisure hours there have been no instances of malicious or wanton injury to property, but,

on the contrary, many proofs of a manly and generous interest in the welfare of the stock, and in the success of every branch of farm economy.

The amount of work performed by students has been limited solely by my ability to furnish employment; indeed, for any work which could be conveniently performed during the intervals of study I have had an embarrassing surplus of zealous, faithful and efficient candidates.

As I have stated in previous reports, the students cannot, on account of their scholastic engagements, be profitably employed to drive the teams; and therefore four men are hired for this duty; but the whole of the work about the barns, the milking, cutting roots and fodder, the cooking of food, feeding, cleaning, carding, sweeping, the training of bulls and colts and the attendance on animals during parturition and in sickness have, as heretofore, all been done by students.

The work last described has mostly occupied the time before and after the regular college exercises. In addition to this, the classes, under the direction of Prof. Stockbridge, have done a very large amount of work in planting, cultivating and harvesting the crops; in clearing the pastures of brush and bogs, preparatory to further improvement; in putting up two hundred rods of post and board fence; in grubbing up useless and unsightly trees; in extensive alterations and improvements in the horticultural department, and in otherwise adding to the value and beauty of the estate.

They have also manifested their interest in the College by buying, digging and bringing home a large number of shrubs and trees from the nursery and from the woods and fields of the neighborhood. These they have set out in groves and avenues on the farm; and as evidence of their skill and care in transplanting, and their perseverance in tending and watering, it should be mentioned that, in spite of the unprecedented drought, not two per cent. of the whole number have died.

Summary.

In concluding my report, I submit the following review of the year's operations:—

By the aid of improved machinery, large crops have been raised and secured with the least possible expense of labor.

Important experiments have been carried on in the cultivation of land, the application of manures, and the growth of plants, and these, when completed and verified, will be duly reported.

The stock has been generally healthy and prosperous, and though, on account of hereditary imperfection, several animals have been sacrificed at a mere fraction of their estimated value, the loss thus sustained is, at least in a measure, atoned for by the opportunities which these cases afforded to the students for study and observation, and by the increased character and value of the animals which are left.

By this course, and by successful competition with breeders of established character, the reputation of the College flocks and herds has been enhanced, and the foundation of a successful career in stock-farming has been added to and strengthened.

The faculty and students have been enabled to study the characteristics and familiarize themselves with the history of animals of the various breeds, and material progress has been made in preparing the way for reliable and valuable experiments in stock-husbandry.

Valuable contributions have been made to the veterinary museum of the College of portraits, hides and skeletons of eminent representative animals; and the carcasses of animals, belonging to the neighboring farmers, which have died of obscure diseases, have been obtained for examination by the veterinary professor and the students.

The improvement of the farm has been diligently and steadily pursued, and important steps have been taken in the process of beautifying the estate, and fitting it for the numerous offices in the collection and diffusion of intelligence, which it now is, or hereafter will be, required to fulfill.

Visitors from all parts of the State and nation, besides many foreigners of distinction, have been welcomed and assisted in examining the farm; and I am greatly encouraged by the fact that several gentlemen who have been prominent in their opposition to the College, have confessed, after a thorough examination, that they had been misinformed and misled, and have expressed their unbounded satisfaction with the course pursued here, and their determination, henceforth, to do all

in their power to promote and sustain the prosperity and reputation of the College.

I forward herewith a detailed statement of my receipts and expenditures. Doubtless, a larger return might have been obtained if present pecuniary profit were the only or supreme aim of the management, but it is submitted that in every department of the farm the strictest economy has been practised, consistent with a proper ambition to do well and thoroughly whatever was undertaken, and, so far as possible, to make the various operations a means of furnishing practical instruction and employment to the students.

The following is a list of the thoroughbred stock belonging to the College:—

Shorthorns.

Bull.—Belvidere (11,364). *Cows.*—Yarico 57th, Belladonna, Peachbud 8th, Aurora 4th, Emma 3d, Autumn Lily, Wistaria, Lilian, Bella Wilfer, Yucatan, Estella, Isabelle and Mabel.

The pedigrees of all these animals are recorded in the Shorthorn Herd-book.

Ayrshires.

Bull.—Lord Ronald. *Cows.*—Beauty (8), Tulip 4th (779), Hattie Logan, Lulie (1,500), Rosa (1,780), Beauty (870), Emily 4th, Beauty 11th, Beauty 12th, Leilah, Little Em'ly, Beauty 13th, Beauty 14th.

These animals have all perfect pedigrees, and are either recorded or will be recorded in the next volume of the Ayrshire Herd-book.

Jerseys.

Bull.—Grand Duke (408). *Cows.*—Hattie (977), Lady Essex (1,059), Success (1,254).

All recorded in American Jersey Herd-book.

Brittanies.

Bull.—Merlin. *Cow.*—Pauline.

Dutch or Holstein.

Bull.—4th Highland Chief (14). *Cow.*—Midwould (19).

Recorded in Holstein Herd-book.

Sheep.

1 Cotswold Ram. 5 Cotswold Ewes.

Swine.

27 Chester Whites, 3 Berkshires, 3 Essex.

Poultry.

Games (4 varieties), 30; Cochins (Partridge and White), 20; Houdans, 6; Gold-spangled Polands, 10; Bronze Turkeys, 14; Rouen Ducks, 2; Pigeons, 50, viz.: Carriers, Pouters, Tumblers (Baldpates, Beards, Splashed and Almond), Fantails, Jacobins, Nuns, Archangels, Turbits, Trumpeters, Quakers, Blue Rocks.

Madagascar Rabbits.

Buck.—Steerforth. *Does.*—Rosa Dartle, Peggotty.

CATALOGUE

OF

Trustees, Overseers, Faculty and Students.

1873.

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SAMUEL T. MAYNARD, B. S.,
Gardener and Assistant Professor of Horticulture.

JOHN C. DILLON, Farm Superintendent.

GRADUATES OF 1873.*

Eldred, Frederick Cornelius,	Sandwich.
Leland, Walter Sherman,	Sherborn.
Lyman, Asahel Hubert,	Westhampton.
Mills, George Westgate,	Medford.
Minor, John Bacon,	Hartford, Conn.
Penhallow, David Pearce,	Portsmouth, N. H.
Renshaw, James Budden,	Richmond.
Simpson, Henry Bell,	Hudson, N. Y.
Wakefield, A. B., Albert Tolman,	Peoria, Ill.
Warner, Seth Smith,	Florence.
Webb, James Henry,	New Haven, Conn.
Wellington, Charles,	Amherst.
Wood, Frank Warren,	Grafton.
Total,	13.

SENIOR CLASS.

Alexander, Edward Percival,	Greenville, Ill.
Babbitt, George Henry,	Columbus, Ohio.
Chandler, Edward Phelps,	Westborough.
Curtis, Wolfred Fletcher,	Westminster.
Dickinson, Asa Williams,	Amherst.
Hitchcock, Daniel Green,	Warren.
Hobbs, John Alden,	No. Hampton, N. H.
Libby, Edgar Howard,	Ashland.
Phelps, Henry Lyman,	Southampton.
Strain, William,	Southwick.
Woodman, Edward Eastman,	Danvers.
Zeller, Harrie McKeen,	Hagerstown, Md.
Total,	12.

JUNIOR CLASS.

Andreae, George Christ,	New York City.
Barrett, Joseph Francis,	Barre.
Barri, John Atherton,	Cambridgeport.

* The annual report being made to the legislature in January necessarily includes parts of two academic years, and the catalogue gives the names of such students as have been connected with the College during any portion of the year 1873.

Bragg, Everett Burt,	Amherst.
Brooks, William Penn,	South Scituate.
Callender, Thomas Russell,	Northfield.
Campbell, Frederick George,	W. Westminster, Vt.
Chase, Edmund Taylor,	Deerfield, N. H.
Clark, Xenos Young,	Amherst.
Clay, Jabez William,	Westminster, Vt.
Dodge, George Rufus,	Hamilton.
Hague, Henry,	Lonsdale, R. I.
Harwood, Peter Mirick,	Barre.
Holmes, Harry Hawley,	Greenwich, N. Y.
Jackson, Henry Stranahan,	Orange, N. J.
Kinsman, Willard Francis,	Ipswich.
Knapp, Walter Haydn,	Boston.
Lee, Lauren Kellogg,	Shrewsbury.
Merrill, James Cushing,	St. Albans, Vt.
Miles, George Melville,	Westminster.
Otis, Harry Preston,	Northampton.
Parker, Francis Greenwood,	Brooklyn, N. Y.
Peabody, Cecil Hobart,	Amherst.
Platt, William Davenport,	Baltimore, Md.
Rice, Frank Henry,	Barre.
Southwick, Andre Arnold,	Mendon.
Winchester, John Frost,	Peabody.
Total,	27.

SOPHOMORE CLASS.

Bagley, David Appleton,	Winchendon.
Chickering, Darius Otis,	Enfield.
De Pew, Richard Mather,	Amherst.
Deuel, Charles Frederick,	Amherst.
Ellis, Edward Story,	Sandwich.
Graves, Louis Bertrand,	South Ashfield.
Guild, George William May,	New York City.
Hawley, Joseph Mather,	Salem, N. Y.
Judd, Charles Adelbert,	South Hadley Falls.
Kendall, Hiram,	Watertown.
Ladd, Thomas Henry,	Watertown.
Lawton, Charles Follen,	New Bedford.
Leach, Frank Hervey,	Amherst.
Mann, George Hewins,	Sharon.
Martin, William Edson,	Hadley.
McConnel, Charles Washington,	Lonsdale, R. I.
McLeod, William Alexander,	Lonsdale, R. I.
Naito, Saitaro,	Chiyoshiu, Japan.
Parker, Edward Herbert,	Reading.

Parker, George Lowell,	Dorchester.
Porter, William Henry,	Hatfield.
Rogers, Mulford Thacher,	Watertown.
Root, Joseph Edward,	Barre.
Sears, John Milton,	Ashfield.
Slade, Denison Rogers,	Chestnut Hill.
Taft, Cyrus Appleton,	Whitinsville.
Tucker, Fred. Herman,	Hardwick.
Urner, George Peter,	Elizabeth, N. J.
Vaill, William Henry,	Enfield.
Wetmore, Howard Graham,	New York City.
Williams, John Elgin,	South Amherst.
Total,	31.

FRESHMAN CLASS.

Ball, Gilman Kimball,	Holyoke.
Benson, David Henry,	Bridgewater.
Clark, Atherton,	Amherst.
Dickinson, Walter Mason,	Amherst.
Goodrich, Wilbur Francis,	East Cambridge.
Gunn, William Bradford,	Sunderland.
Hibbard, Joseph Robinson,	Chester, Vt.
Howe, Waldo Vernon,	Framingham.
Mills, James Kellogg, Jr.,	Springfield.
Moore, Frank Lester,	Framingham.
Nye, George Everett,	Sandwich.
Paige, Harrie Cruse,	Tarrytown, N. Y.
Palmer, Frank Waldo,	Amherst.
Parker, Henry Fitch,	Amherst.
Pixley, Martin Shaw,	West Hawley.
Porto, Raymundo,	Para, Brazil.
Smith, Frank Leland,	Springfield, N. Y.
Southmayd, John Edwards,	Middletown, Conn.
Southworth, Charles Heyward,	Springfield.
Urner, Frank Gordon,	Elizabeth, N. J.
Wilson, Alvin Robert,	South Hadley.
Wayesugi, Tall Katuyoshi,	Tokeio, Japan.
Wyman, Joseph,	Arlington.
Total,	23.

SELECT CLASS.

Barstow, William Hale,	Haverhill, N. H.
Benedict, John Mitchell,	Bethel, Conn.
Blanchard, William Henry,	Putney, Vt.
Bond, Henry,	Ware.
Bunker, Madison,	Nantucket.
Carter, Walter Edward,	Boston.
Dix, James Quincy,	Boston.
Frothingham, Thomas Goddard,	Boston.
Gibbs, Charles Finney,	Thetford, Vt.
Gillett, Edward,	Southwick.
Jefts, Melvin Willard,	Ashby.
Lyman, Henry,	Middlefield, Conn.
Mallory, West Allen,	Ogdensburg, Wis.
Mildeberger, Victor,	New York City.
Montague, Arthur Huntington,	South Hadley.
Moody, George Frederick,	Springfield.
Nakashima, Masanogio,	Chiyoshiu, Japan.
Parker, George Amos,	Gardner.
Perkins, William Henry,	Watertown.
Player, Harry Heyward,	Nashville, Tenn.
Potter, William Stiles,	Lafayette, Ind.
Preston, Edward George,	Elbridge, N. Y.
Reed, Fremont Sumner,	South Weymouth.
Robinson, John Albert,	Brookline.
Sanger, Frank Hyde,	Watertown.
Spooner, Frank Adams,	Barre.
Smith, Frank Stockbridge,	Springfield.
Smith, Thomas Edwin,	Chesterfield.
Swift, Frank Munroe,	Yarmouth.
West, Frank Howard,	Haverhill.
Zeller, William Melville,	Hagerstown, Md.
Total,	31.

RESIDENT GRADUATES.

Minor, B.S., John Bacon,	Hartford, Conn.
Wellington, B. S., Charles,	Amherst.
Total,	2.

SUMMARY.

Graduates of 1873,	13
Resident graduates,	2
Seniors,	12
Juniors,	27
Sophomores,	31
Freshmen,	23
Select,	31
Total,	139

Catalogue of Past, Regular and Special Students of the College, with their present Occupations and Residences, so far as known.

Adams, Frank E., Mechanic, Hadley.
Alexander, Edward P., Clerk, office St. Louis & S. E. R. R. Co., St. Louis, Mo.
Allen, B. S., Gideon H., Farmer, North Conway, N. H.
Ames, William C., Farmer, Conway.
Andreae, George C., Clerk, New York City.
Annable, Robert W., Civil Engineer, Portsmouth, N. H.
Ariail, Smith, Farmer, Stockbridge.
Ashton, John, Student (deceased), Newton Centre.
Avery, Frank A., Student, Commercial College, Poughkeepsie, N. Y.
Babbitt, George H., Cadet, Naval Academy, Annapolis, Md.
Baker, Fred. W., Baker & Hamilton, Hardware, San Francisco, Cal.
Bancroft, John F., Farmer, Tyngsborough.
Barber, Strong H., Farmer, Windsor, Ct.
Bardwell, Daniel P., Farmer, Shelburne.
Barker, Jr., Charles A., Farmer, Charlestown.
Barreto, Fiuza, Planter, Bahia, Brazil.
Barrows, Fletcher K., Dealer in Coal, Brattleboro', Vt.
Barrows, William, Jeweler, Amherst.
Bassett, B. S., Andrew L., Civil Engineer, Erie & Oil City R. R.
Bayley, Jonathan, Mechanic, Northampton.
Bell, B. S., Burleigh C., Druggist, Vallejo, Cal.
Bell, George H., Farmer, Amherst.
Birnie, B. S., William P., Civil Engineer, Springfield.
Blankenship, Edwin A., Shoe Manufactory, North Bridgewater.
Bliss, Albert N., Farmer, Des Moines, Iowa.
Blood, Alonzo H., Principal High School, Walpole.
Blunt, Charles E., Concord, N. H.
Bowker, B. S., William H., Manufacturer of Fertilizers, Boston.
Brainard, John W., Farmer, Palmer.

Brett, B. S., William F., Brigham & Brett, Dealers in Clothing, Fall River.
Breck, Webster, Book-keeper, Newtonville.
Briggs, Louis W., Planter, Plaquemine, La.
Brown, Clarence E., Machinist, Florence.
Bullard, M. D., William E., Physician, New York City.
Capen, M. D., Thomas A., Physician, Fall River.
Carruth, Herbert S., Clerk, Carruth & Sweetser, Boston.
Carter, Herbert M., Book-keeper, Boston.
Carter, Samuel M., Dairy Farmer, West Berlin.
Casey, Michael F., Druggist, L. M. Shute, New York City.
Caswell, B. S., Lilley B., Civil Engineer, Athol.
Cary, William H., Civil Engineer (deceased Jan 7, 1873).
Chapman, Edward B., Merchant, New York City.
Chase, Edmund T., Farmer, Deerfield Centre, N. H.
Childs, William F., Clerk, Canadian Bank of Commerce, Montreal, Can.
Clark, Charles T., Clerk in Store, Sherborn.
Clark, B. S., John W., Foreman, Nonantum Hill Nursery, Brighton.
Clark, Lysander L., Farmer, Easthampton.
Clark, Wallis O., Cadet, West Point, N. Y.
Clark, William A., Student (deceased), Springfield.
Clark, William J., Clerk, Sheet Metal Co., Salem, Ohio.
Cleland, William F., Clerk in Store, Natick.
Codina, Gabriel, Barcelona, Spain.
Colby, Daniel J., Printer, Newburyport.
Cole, Daniel P., Clerk, Morgan Envelope Co., Springfield.
Cook, Charles M., Merchant, Honolulu, H. I.
Cook, Rufus L., Druggist, Hadley.
Copp, Belton A., Clerk, Vermilye & Co., New York City
Cowles, Elliot A., Farmer, Kellogg, Iowa.
Cowles, B. S., Frank C., Farmer, Amherst.
Cowles, B. S., Homer L., Farmer, Hadley.
Cowles, Walter D., Farmer, Amherst.
Crocker, Jr., Loring, Clerk, Bray & Hayes, Boston.
Cutter, B. S., John C., Medical Student, Hanover, N. H
Damon, Edward, Merchant, Honolulu, H. I.
Dean, Charles T., Columbus, Ga.
Deland, Thomas J., Student (deceased Nov. 7, 1873), Boston.
De Pew, Richard M., Clerk, Talcot & Post, Hartford, Ct.
Dickinson, Asa W., Farmer, Amherst.
Dix, James Q., Farmer, Boston.
Doubleday, H. M., Chemist, Brooklyn, N. Y.
Doubleday, William H., Book-keeper, Brooklyn, N. Y.
Duncan, George A., Agent Boswell's Reflected Heater, Hartford, Ct.
Dyer, B. S., Edward N., Teacher of High School, North Weymouth.
Eastman, George H., Teacher, Storm Lake, Iowa.
Easterbrook, Isaac H., Book-keeper, Hingham Centre.
Eaton, Harry Ahpeetcha, Student, Santee Agency, Neb.
Eldred, Fred. C., North British and Mercantile Insurance Co., New York.
Ellis, Granville A., Clerk, Hayden, Gardenier & Co., Boston.

Ellsworth, B. S., Emory A., Civil Engineer, Davis & Ellsworth, Holyoke.
Ely, William J., Farmer, Freehold, N. J.
Fisher, B. S., Jabez F., Lovell & Co., Engineers' Supplies, Fitchburg.
Fisk, Charles A., Clerk, Wason Car Manufacturing Co., Springfield.
Fisk, B. S., Edward R., Salesman, Folwell & Brs., Philadelphia, Penn.
Flagg, B. S., Charles O., Farmer, Westminster.
Flower, Archibald D., Clerk, Ashfield.
French, John L.
Frisbie, George D., Clerk, Burdick, Frisbie & Co., New York City.
Frothingham, T. G., Book-keeper, Boston.
Fuller, B. S., George E., Civil Engineer, Toledo, Ohio.
Furness, George A., Clerk, Liv., London & Globe Ins. Co., New York City.
Garrett, William E., Clerk, West Newton.
Garrigues, S. S., Ph. D., State Inspector of Salt, East Saginaw, Mich.
Gibbs, Charles, Florist and Nurseryman, H. P. Closson, Thetford, Vt.
Gillett, Edward, Trout-raising and Farming, Southwick.
Graves, George G., Book-keeper, Amherst.
Green, Frank B., Farmer, Amherst.
Green, William H., House and Sign Painter, Maywood, Ill.
Grover, B. S., Richard B., Book-keeper, Amherst.
Gunn, Charles B., Civil Engineer, Denison, Texas.
Hall, Frederick A. (deceased), Amherst.
Hall, Lemuel W., Dealer in Meats, Lowell.
Hardy, Edward E., Agent Norwich Worsted Co., Norwich, Ct.
Harrington, Frank W., Mechanic, North Amherst.
Hatch, George S., Student, Boston.
Hawley, B. S., Frank W., Lumber Business, Springfield.
Healey, George C., Farmer, Hampton Falls, N. H.
Herrick, B. S., Fred. St. C., Farmer, Methuen.
Heyl, B. S., Jacob, Sugar Refiner, Philadelphia, Penn.
Hobbs, John A., Civil Engineer, North Hampton, N. H.
Holmes, B. S., L. LeB., Law Student, New Bedford.
Howe, Edward G., Farmer, Lansing. Ill.
Howland, Charles M., Dry Goods, Worcester.
Hubbard, Frank, Dentist, San Francisco, Cal.
Jefts, Melvin W., Farmer, Ashby.
Johns, Arthur C., Wholesale Grocer, St. Louis, Mo.
Johns, Fred. D., Medical Student, St. Louis, Mo.
Judd, Charles A., Farmer, South Hadley Falls.
Judkins, Arthur M., Salesman, New England Carpet Co., Boston.
Kelleher, David W., Clerk, Steamboat (deceased).
Kimball, B. S., Francis E., Foreman, Cinn. Transfer Co., Cincinnati, Ohio.
King, Albert, Groceries and Grain, Taunton.
King, John E., Mech. Engineer, New York City.
Kingman, W. H., Hotel-keeper, Westfield, N. J.
Kinsman, W. F., Civil Engineer, Charlestown.
Lathrop, Joseph D., Farmer, Northampton.
Leach, Frank H., Printing Office, Amherst.
Leland, B. S., Walter S., Law Student, Sherborn.

Leonard, B. S., George, Law Student, New Bedford.
Lester, Frank H., Clerk, Preston, Keen & Co., Chicago, Ill.
Livermore, B. S., R. W., Law Student, Yale College, New Haven, Ct.
Lockey, J. M., Insurance Agent, Leominster.
Luther, Gardner C., Farmer, Rehoboth.
Lyman, Arthur W., Farmer, Southampton.
Lyman, B. S., Asahel H., Medical Student, Manistee, Wis.
Lyman, B. S., Robert W., Civil Engineer, Northampton.
Lyman, William, Farmer, Middlefield, Conn.
Lyon, William S., Wool-grower, Anaheim, Cal.
Mackie, B. S., George, Medical Student, New Bedford.
Mallory, West. A., Farmer, Ogdensburg, Wis.
Maynard, B. S., Samuel T., Gardener, Mass. Ag. Coll., Amherst.
Merrill, James C., Civil Engineer, St. Albans, Vt.
Merrill, Nathaniel P., Farmer, Wilbraham.
Merriam, Joel H., Clerk, Westminster.
Millard, David K., Draughtsman, Northampton.
Miller, Henry L., Dealer in Meats, Greenfield.
Mills, B. S., George W., Student of Pharmacy, Medford.
Mines, William W., Medical Student, Montreal, Canada.
Minor, B. S., John B., Student of Chemistry, Mass. Ag. Coll., Amherst.
Moody, George F., Bell-hanger, Springfield.
Morey, B. S., Herbert E., Clerk, Morey & Smith, Boston.
Morris, Frederick W., Bookseller, Springfield.
Morse, B. S., James H., Civil Engineer, Salem.
Nakashima, Masanojio, Agricultural Department, Japan.
Nash, Arthur H., Farmer, Hadley.
Nash, Edwin D., Brakeman, Vt. Central R. R., White River Junction, Vt.
Nomura, Ichiskay, Agricultural Department, Japan.
Norcross, B. S., Arthur D., Manufacturer of Straw Goods, Monson.
Nichols, B. S., Lewis A., Civil Engineer, Danvers.
Ober, Frederick A., Naturalist, St. Lucie, Brerara Co., Florida.
Ould, Remus, Farmer, Baltimore, Md.
Page, B. S., Joel B., Farmer, Conway.
Parker, Francis G., Civil Engineer, Ariquipa, Peru.
Peabody, B. S., William R., Clerk, R. R. Office, Lincoln, Neb.
Penhallow, B. S., David P., Transitman, P. & D. R. R., Portsmouth, N. H.
Penhallow, Charles L., Farmer, York, Maine.
Perkins, William H., Clerk, Watertown.
Phelps, John, Teacher, Milo, Ill.
Player, Harry H., Business, Chicago, Ill.
Post, Henry W., Medical Student, Burlington, Vt.
Preston, Edward G., Farmer, Elbridge, N. Y.
Rankin, Austin A., Farmer, Pelham.
Reed, Fremont S., Boot and Shoe Manufacturer, South Weymouth.
Renshaw, B. S., James B., Farmer, Richmond.
Richmond, B. S., S. H., Surveyor and Draughtsman, Fall River.
Rotch, Caleb L., Theological Student, Boston University.
Rowland, Clarence W., Farmer, Newton.

Russell, B. S., William D., Chemist, Turner's Falls.
Salisbury, B. S., Frank B., Farmer, Sherborn.
Sanderson, Charles F. (deceased), Petersham.
Sanderson, Robert W., Clerk, Richards & Thayer, Holyoke.
Sanger, Frank H., Clerk, Watertown.
Sanger, Herbert C., Clerk, G. F. & W. H. Ordway, Boston.
Shaw, B. S., Elliot D., Dealer in Grain, &c., Chicopee.
Simpson, B. S., Henry B., Farmer, Centerville, Maryland.
Slade, Denison R., Classical Student, Chestnut Hill.
Slattery, William, Lawyer, Holyoke.
Smead, B. S., Edwin, Farmer, Baltimore, Md.
Smith, James M., Union Steam and Water Heating Apparatus, Westfield.
Smith, Joseph B., Brick Manufacturer, Newburyport.
Smith, William H., Smith & Co., Stafford Springs, Ct.
Smith, William O., Sheriff, Koloa, H. I.
Snow, B. S., G. H., Farm Superintendent, North Andover.
Snow, Laban, Clerk, Harwich Port.
Somers, B. S., F. M., Editor "Leavenworth Times," Leavenworth, Kansas.
Southwick, A. L., Farmer, Auburn.
Sparrow, B. S., Lewis A., Manufacturer of Fertilizers, Boston.
Spooner, Frank A., Insurance Office, Foster & Cole, Boston.
Stearns, Richard S., Law Student, Boston University.
Strain, Jr., William, Merchant, Southwick.
Strickland, B. S., George P., Machinist, South Newmarket, N. H.
Swazey, Walter W., Dentist, Springfield.
Swift, Frank M., Clerk, H. C. Thacher & Co., Boston.
Swift, George A., Farmer, Charlestown.
Taylor, Ralph I., Clerk, Wholesale Grocery, Oswego, N. Y.
Thomas, George H., Farmer, Lebanon, Ct.
Thomas, John L., Clerk, M. S. Underwood, State Liquor Com., Boston.
Thompson, B. S., E. E., Druggist, Whipple & Co., North Bridgewater.
Thompson, B. S., S. C., Civil Engineer, Boston Water Works, Natick.
Towne, Frank A., Druggist, Culmer, Iowa.
Tucker, Charles E., J. Tucker & Co., Boston.
Tucker, B. S., George H., Civil Engineer, City Engineer, Corry, Penn.
Tucker, Wilson M., Farmer, Monson.
Vaill, William H., Mechanic, Worcester.
Vose, Edwin F., Medical Student, Marion.
Wakefield, A. B., B. S., A. T., Teacher, Univ. of E. Tenn., Knoxville, Tenn.
Ware, B. S., Willard C., Farmer, Hamilton.
Warner, B. S., Seth S., Civil Engineer, Florence.
Warriner, Alfred A., Farmer, Warren.
Watkis, James E., Farmer, Kinderhook, N. Y.
Webb, B. S., Jas. H., Student, Sheffield Scientific School, New Haven, Ct.
Weeks, Herman F., Student (deceased), Babylon, N. Y.
Wellington, B. S., Chas., Student of Chemistry, Mass. Ag. Coll., Amherst.
Wells, B. S., Henry, C. E., N. Y. Cent. & Huds. R. R. R., Rochester N. Y.
Wheeler, Chas. A., Railroad Contractor, Milwaukee, Wis.
Wheeler, B. S., William, Agricultural Engineer, Boston.

Whitney, B. S., William C., Architect, with Carl Fehmer, Boston.
Whitney, B. S., F. Le P., Farmer and Florist, Hingham Centre.
Wills, John W., Clerk, Bray & Hayes, Boston.
Wood, B. S., Frank W., Civil Engineer, Rochester, N. Y.
Woolson, George C., Assist. Editor " Hearth and Home," New York City.
Wright, Augustus H., Superintendent Lumber-yard, Geo. Curtis, Boston.
Yamao, Tenetaro, Agricultural Department, Japan.
Youchi, Geamon, Agricultural Department, Japan.
Zeller, Bruce S., Farmer, Hagerstown, Md.

COURSE OF STUDY AND TRAINING.

Freshman Year.

First Term.—Chemical Physics, 5 hours each week; Human Anatomy, Physiology and Hygiene, 3 hours; Algebra, 5 hours; English, 2 hours; Agriculture, 3 hours; Declamation, 1 hour; Free-hand Drawing, 2 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

Second Term.—Inorganic Chemistry, 4 hours; Human Anatomy, Physiology and Hygiene, 3 hours; Geometry, 5 hours; Agriculture, 4 hours; English, 2 hours; Elocution, 1 hour; Free-hand Drawing, 2 hours; Military Drill, 4 hours.

Third Term.—Organic and Practical Chemistry, 8 hours; Geometry, 4 hours; French, 5 hours; Elocution, 1 hour; Agriculture, 2 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

Sophomore Year.

First Term.—Agricultural and Analytical Chemistry, 8 hours each week; Analytical Geometry, 4 hours; French, 5 hours; Agriculture, 2 hours; Declamation, 1 hour; Military Drill, 4 hours; Manual Labor, 6 hours.

Second Term.—Quantitative Chemical Analysis, 7 hours; Trigonometry, 5 hours; French, 4 hours; Agriculture, 4 hours; Declamation, 1 hour; Military Drill, 4 hours.

Third Term.—Zoölogy, 5 hours; Surveying, 5 hours; Agriculture, 2 hours; English, 3 hours; Declamation, 1 hour; Drawing, 4 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

Junior Year.

First Term.—German, 5 hours each week; Mechanics, 5 hours; Entomology and Zoölogy, 3 hours; Market-gardening, 2 hours; Levelling and Drawing, 5 hours; Military Drill, 3 hours; Manual Labor, 6 hours.

Second Term.—German, 4 hours; Physics, 5 hours; Botany, 4 hours; Microscopy, 2 hours; Drawing, 4 hours; Agricultural Debate, 1 hour; Military Drill, 4 hours.

Third Term.—German, 4 hours; Astronomy, 4 hours; Botany, 4 hours; Topographical Surveying, 4 hours; Stock and Dairy Farming, 2 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

Senior Year.

First Term.—English Literature, 4 hours each week; Botany, 2 hours; Veterinary Science, 3 hours; Book-keeping, 2 hours; Roads and Rail-

roads, 5 hours; Drawing, 3 hours; Original Declamation, 1 hour; Military Drill, 3 hours; Manual Labor, 6 hours.

Second Term.—English Literature, 4 hours; Mental Science, 4 hours; Arboriculture, 2 hours; Veterinary Science, 3 hours; Drawing, 3 hours; Military Drill, 4 hours.

Third Term.—Veterinary Science, 5 hours; Geology, 3 hours; Landscape Gardening, 2 hours; Rural Law, 1 hour; Agricultural Review, 4 hours; Military Drill, 4 hours.

CALENDAR FOR 1874.

The second term of the collegiate year begins January 1st, and continues till April 1st.

The third term begins April 16th, and continues till July 15th.

The first term begins August 27th, and continues till the Wednesday before Thanksgiving.

There is an examination of candidates for admission to the College, at the Botanic Museum, at 9 A. M., Tuesday, July 14th, and also on Thursday, August 27th.

The annual public examination and the Farnsworth Prize Declamations take place Monday, July 13th.

The public examination of the graduating class for the Grinnell Prize for excellence in Agriculture, and the Address before the Literary Societies take place on Tuesday, July 14th. The exercises of Graduation Day occur July 15th.

There will be a reunion of the Pioneer Class of 1871, on Tuesday, July 14th.

ADMISSION.

Candidates for admission to the Freshman Class are examined, in writing, upon the following subjects: English Grammar, Geography, Arithmetic, Algebra, through simple equations, and the History of the United States.

Candidates for higher standing are examined as above and also in the studies gone over by the class to which they may desire admission.

No one can be admitted to the College until he is fifteen years of age, and every student is required to furnish a certificate of good character, from his late pastor or teacher, and to give security for the prompt payment of term bills. Tuition and room-rent must be paid in advance at the beginning of each term, and bills for board, fuel, &c., at the end of every term.

The regular examinations for admission are held at the Botanic Museum, at 9 o'clock, A. M., on Tuesday, July 14th, and on Thursday,

August 27th; but candidates may be examined and admitted at any other time in the year.

Further information may be obtained from President W. S. Clark, Amherst, Mass.

EXPENSES.

Tuition, ...	$25 00	per term.
Room-rent, ...	5 00 to 10 00	"
Board, ...	3 50	per week.
Expenses of Chemical Laboratory to Students of Practical Chemistry, ...	10 00	per term.
Public and private damages, including value of chemical apparatus destroyed or injured,	at cost.	
Annual expenses, including books, ...	300 00 to 350 00.	

REMARKS.

The regular course of study occupies four years, and those who complete it receive the degree of Bachelor of Science.

The instruction in the languages is intended to qualify the graduates to write and speak English with correctness and effect, and to translate German and French with facility. The scientific course is as thorough and practical as possible, and every science is taught with constant reference to its application to agriculture and the wants of the farmer.

The instruction in agriculture and horticulture includes every branch of farming and gardening which is practised in Massachusetts, and is both theoretical and practical. Each topic is discussed thoroughly in the lecture-room, and again in the plant-house or field, where every student is obliged to labor. The amount of required work, however, is limited to six hours per week, in order that it may not interfere with study. Students are allowed to do additional work, provided they maintain the necessary rank as scholars. All labor is paid at the rate of ten to twenty cents per hour, according to its value. There is no provision for indigent students beyond the opportunity to do such work as may offer about the public and farm buildings, or in the field, and it is hardly possible to earn more than from $50 to $100 per annum, besides performing other duties. So far as is consistent with circumstances, students will be permitted to select such varieties of labor as they may for special reasons desire to engage in.

Those who pursue a select course attend recitations and lectures with the regular classes; but those properly qualified, who desire special instruction in chemistry, civil engineering, veterinary science, agriculture

or horticulture may make private arrangements with the officers having charge of these departments.

An expenditure of from $10 to $50 is necessary to provide furniture, which may be purchased at reasonable rates, either new or second-hand.

On Sundays, students are expected to attend the chapel service and Bible class which are conducted by the Professor of Moral Science. While the Bible is made the basis of all religious instruction, everything of a denominational character is as far as practicable avoided.

Students may, upon the written request of their parents or guardians, be excused from these exercises to attend services in one of the churches of the town.

REGULATIONS.

1. Students are specially forbidden to combine together for the purpose of absenting themselves from any required exercise, or violating any known regulation of the College.

2. The roll shall be called five minutes after the ringing of the bell for each exercise of the College by the officer in charge, unless a monitor be employed, and students who do not answer to their names shall be marked absent; provided that any student coming in after his name has been called shall be marked tardy. Two tardinesses shall be reckoned as one absence.

3. Absence from a single exercise may be allowed or excused by the officer in charge of the same; but permission to be absent from several exercises must be obtained from the general excusing officer or from the president. In such cases the officer excusing will furnish a certificate of excuse, which shall state the precise time for which absence is permitted, and which shall be a satisfactory reason for absence from all exercises occurring within the time specified.

4. Absence without permission obtained beforehand will not be excused by any member of the faculty except on the presentation of a satisfactory excuse written upon the prescribed blank form. Excuses must be rendered to the officer in charge of the exercise from which the student was absent; except that when the absence may include two or more days, the excuse may be rendered to the president, whose approval shall be deemed sufficient for all absences specified within.

Excuses must be rendered promptly; no officer will be expected to receive an excuse after one week has elapsed from the end of the absence, if there has been an opportunity for presentation.

Excuses deemed satisfactory will be returned to the student with the indorsement of the approving officer. Excuses deemed insufficient will be retained and referred to the faculty for their decision.

5. For every absence for which no excuse may be offered, or if offered shall be deemed insufficient by the faculty, the absentee shall be charged with a fine of one dollar upon the treasurer's accounts, and no student may enter upon the duties of a term, or receive an honorable discharge,

certificate of attendance or diploma until all fines previously incurred are paid.

6. Whenever the aggregate number of unexcused absences in all departments reaches five, the student so delinquent shall be informed of the fact. When the number of such absences reaches eight, the parent or guardian of the student shall be notified of his delinquency; and when ten such delinquencies are justly recorded against any student his connection with the College may be terminated.

7. Students are forbidden to absent themselves without excuse from the regular examinations, to give up any study without permission from the president, or to remove from one room to another without authority from the officer in charge of the dormitory buildings.

8. The record of deportment, scholarship and attendance will be carefully kept, and whenever the average rank of a student for any term falls below fifty he will not be allowed to remain a member of the College, except by a special vote of the faculty.

Admission to the College and promotion from class to class as well as to graduation are granted only by vote of the faculty.

9. Students are required to abstain from everything injurious to the buildings and other property of the College, and in all respects to be gentlemen.

10. Students will not be excused from regular duty to engage in boating.

BOOKS, APPARATUS, AND SPECIMENS IN NATURAL HISTORY.

The library of the College contains about 1,500 volumes. Among them are several valuable sets of cyclopædias, magazines and newspapers, reports of agricultural societies and State boards of agriculture and many standard works on agriculture and horticulture. There are many useful works of reference in chemistry, botany, surveying and drawing. The larger part of the books have been presented to the institution by private individuals.

The faculty and students also have the privilege of drawing books from the excellent library of Amherst College, which contains nearly 30,000 volumes.

The State cabinet of specimens illustrating the geology and natural history of Massachusetts has been removed from Boston to the College, and is of much value for purposes of instruction.

The Knowlton herbarium contains more than 10,000 species of named botanical specimens, besides a large number of duplicates. The botanic museum is supplied with many interesting and useful specimens of seeds, woods and fruit models. There is also a set of diagrams illustrating structural and systematic botany, including about 3,000 figures.

About 1,000 species and varieties of plants are cultivated in the Durfee plant-house, affording much pleasure and information to students of both Colleges.

The very extensive, and in many respects, unsurpassed collections in geology, mineralogy, natural history and ethnology, belonging to Amherst College, are accessible to members of the Agricultural College.

The chemical, engineering and military departments of the Agricultural College, are well furnished.

The armory contains two brass pieces of artillery, fifty sabres and one hundred and fifty breech-loading rifles.

FARNSWORTH RHETORICAL MEDALS.

Isaac D. Farnsworth, Esq., of Boston, has generously provided a fund of $1,500, the income of which is to be used for the purchase of gold and silver medals, to be annually awarded under the direction of the College faculty for excellence in Declamation.

GRINNELL AGRICULTURAL PRIZES.

Hon. William Claflin, of Boston, has given the sum of $1,000 to establish a fund for the endowment of a first prize of $50 and a second prize of $20, to be called the Grinnell Agricultural Prizes, in honor of George B. Grinnell, Esq., of New York. These prizes are to be paid in cash to those two members of the graduating class who may pass the best oral and written examination in Theoretical and Practical Agriculture.

PEABODY ENTOMOLOGICAL PRIZE.

Prof. S. H. Peabody offers a prize of $20 for the best collection of insects made during the collegiate year ending July 15th, 1874. The collection must contain not less than 250 specimens, neatly mounted and correctly named, and found on the College estate.

HILLS BOTANICAL PRIZES.

For the best herbarium, collected by a member of the class of 1875, a prize of $15 is offered, and for the second best a prize of $10; also a prize of $5 for the best collection of woods.

FINANCIAL STATEMENT,

JANUARY 1, 1874.

REAL ESTATE.

College Farm and Quarry,	$37,500 00
South College,	36,000 00
North College,	36,000 00
College Hall,	30,000 00
South Boarding-house,	8,000 00
North Boarding-house,	8,000 00
Durfee Plant-house,	12,000 00
Botanic Museum,	5,000 00
South Barn,	14,500 00
Farm-house,	4,000 00
Four Dwellings and Barns, purchased with the estate,	9,000 00
Total Real Estate,	$200,000 00

FARM STATEMENT.

Value of Live-stock,	$10,650 00
Vehicles and Implements,	2,634 00
Produce on hand,	5,246 00
	$18,530 00

Total credits of Farm, including property inventoried Jan. 1, 1873, credit for labor performed in grading, &c., and receipts from sales of live-stock and produce,	$24,649 65
Total debits of Farm, including property inventoried Jan. 1, 1873, and all expenditures for live-stock, labor, implements, repairs, seeds, fertilizers, &c.,	$24,517 86

FUND FOR MAINTENANCE OF THE COLLEGE,

IN CHARGE OF THE STATE TREASURER.

The total amount received from the sale of 360,000 acres of land, given to Massachusetts for the endowment of one or more colleges for the promotion of education in agriculture and the mechanic arts, was	$236,307 40
Of this amount, in accordance with the Act of Congress, was expended for a farm, ...	29,778 40

The sum of $208,464.65, which was received for $\frac{9}{10}$ of the land-scrip was constituted, in 1863, a perpetual fund for the promotion of education in agriculture and the mechanic arts. In 1871, this fund was increased by the legislature to $350,000.

The investments of this fund, made by the State treasurer, are as follows:—

United States bonds,	. 5–20's, interest 6 per cent., gold, .	$50,500 00
" "	. 10–40's, " 5 " " .	30,000 00
Massachusetts "	. 5 per cent., gold, ...	24,000 00
" "	. 6 " currency, . . .	3,000 00
City of Salem "	. 6 " "	55,000 00
" Lynn "	. 6 " "	25,000 00
Town of Milford bonds,	6 " "	14,200 00
" Plymouth note,	6 " "	6,724 65
" Brighton "	6½ "	10,000 00
" West Roxbury note,	7 per cent., ...	80,000 00
County of Hampden	" 6½ "	50,000 00
Cash in Treasury,	. . . .	1,575 35
Total Fund,	. . . .	$350,000 00

Annual Income of Fund at 6 per cent., ...	$21,000 00

Two-thirds of this income is by law paid to the treasurer of the College, and one-third to the treasurer of the Institute of Technology.

Income of College from Endowment Fund, ...	$14,000 00
By the conditions of the gift, none of the income of the fund derived from the sale of land-scrip can be used for the erection or repair of buildings.	
The Hills Fund of $10,000, for the maintenance of the Botanic Garden, is in charge of the College treasurer, and at present yields an income of	500 00
Total Income from Funds, ...	$14,500 00

To this sum should be added the receipts of tuition and room-rent, amounting to $100 per annum for each scholar, and the receipts from the sale of the products of the farm and garden.

DR. MASSACHUSETTS AGRICULTURAL COLLEGE *in account with* NATHAN DURFEE, *Treasurer.* CR.

1873.			1873.		
Jan. 1,	To Balance,	$3,372 28		To Salaries,	$19,540 89
	Income Hills Fund,	500 00		Board of Students,	4,281 82
	State Endowment Fund,	14,982 91		Expenses Hills Fund,	725 73
	Receipts from Students,	9,395 51		Contingent account,	6,465 90
	from Farm Superintendent,	1,607 69		Term Bill account,	2,315 12
	from Gardener,	580 59		Botanical account,	274 75
	from Bills payable,	10,460 00		Farm account,	4,548 55
				Interest account,	371 16
			Dec. 31,	Balance,	2,875 06
		$41,398 98			$41,398 98

Respectfully submitted,

NATHAN DURFEE, *Treasurer.*

I have examined the treasurer's accounts and find them correctly stated and accompanied by the proper vouchers.

HENRY COLT, *Auditor.*

SUMMARY OF METEOROLOGICAL OBSERVATIONS

For the Year 1873,

TAKEN AT AMHERST, MASS.,

By Professor E. S. SNELL, LL.D., of Amherst College.

Latitude 42° 22′ 17″. Longitude 72° 34′ 30″. Elevation above the sea level, 267 feet.

SUMMARY OF METEOROLOGICAL OBSERVATIONS FOR 1873.

MONTHS.	Thermometer in the Open Air. Maximum.	Minimum.	Mean.	Rain and Snow. Am't of rain or melted snow in gauge, inches.	Depth of snow, inches	Clouds. Mean per cent. of sky.	Winds. Per cent. of time and force. Northwest.	Southwest.	Southeast.	Northeast.	Barometer. Barometer height reduced to freezing point. Maximum.	Minimum.	Mean.	Force or Pressure of Vapor, in Inches. Max.	Min.	Mean.	Relative Humidity or Fraction of Saturation. Max.	Min.	Mean.
January,	42.3	-22.0	20.56	5.013	12.0	56	52	6	19	23	30.387	29.285	29.781	.299	.017	.096	100	33	77
February,	45.0	-2.5	24.00	2.174	17.0	48	70	8	14	8	30.173	29.036	29.648	.257	.026	.099	95	41	70
March,	49.3	1.8	30.64	3.176	6.0	54	56	11	20	13	30.327	28.645	29.599	.284	.039	.122	98	35	69
April,	66.2	33.5	43.23	1.738	–	57	57	9	11	23	29.981	29.285	29.637	.339	.107	.175	97	31	68
May,	82.0	39.0	54.58	3.910	–	49	42	12	32	14	30.155	29.198	29.722	.734	.125	.287	96	25	64
June,	90.0	50.6	67.48	1.592	–	28	41	20	33	6	30.119	29.281	29.694	.787	.196	.415	95	31	63
July,	92.4	56.1	71.30	2.927	–	46	46	21	29	4	30.027	29.492	29.756	.822	.229	.561	98	28	75
August,	86.2	49.1	67.01	3.468	–	51	40	14	25	21	30.077	29.535	29.791	.795	.265	.498	99	36	76
September,	85.8	36.2	60.35	4.765	–	43	44	28	23	5	30.173	29.370	29.791	.831	.186	.412	99	33	77
October,	70.5	27.0	49.93	6.357	–	39	42	15	28	15	30.223	29.227	29.744	.641	.107	.274	96	28	73
November,	52.0	6.5	29.68	3.509	13.5	54	58	11	15	16	30.311	28.509	29.637	.249	.049	.123	97	33	71
December,	57.7	7.0	29.23	3.308	19.0	64	49	6	24	21	30.436	28.947	29.819	.453	.037	.134	100	39	76
YEAR,	92.4	-22.0	45.67	41.937	67.5	49	50	13	23	14	30.436	28.509	29.718	.822	.017	.266	100	25	72